



REFERENCE: BASE MAP USGS 7.5 MIN. QUAD., BURLINGTON, VERMONT, 1948, PHOTOREVISED 1987.

2000' 0 2000'

Approximate Scale: 1" = 2000'

Area
Location

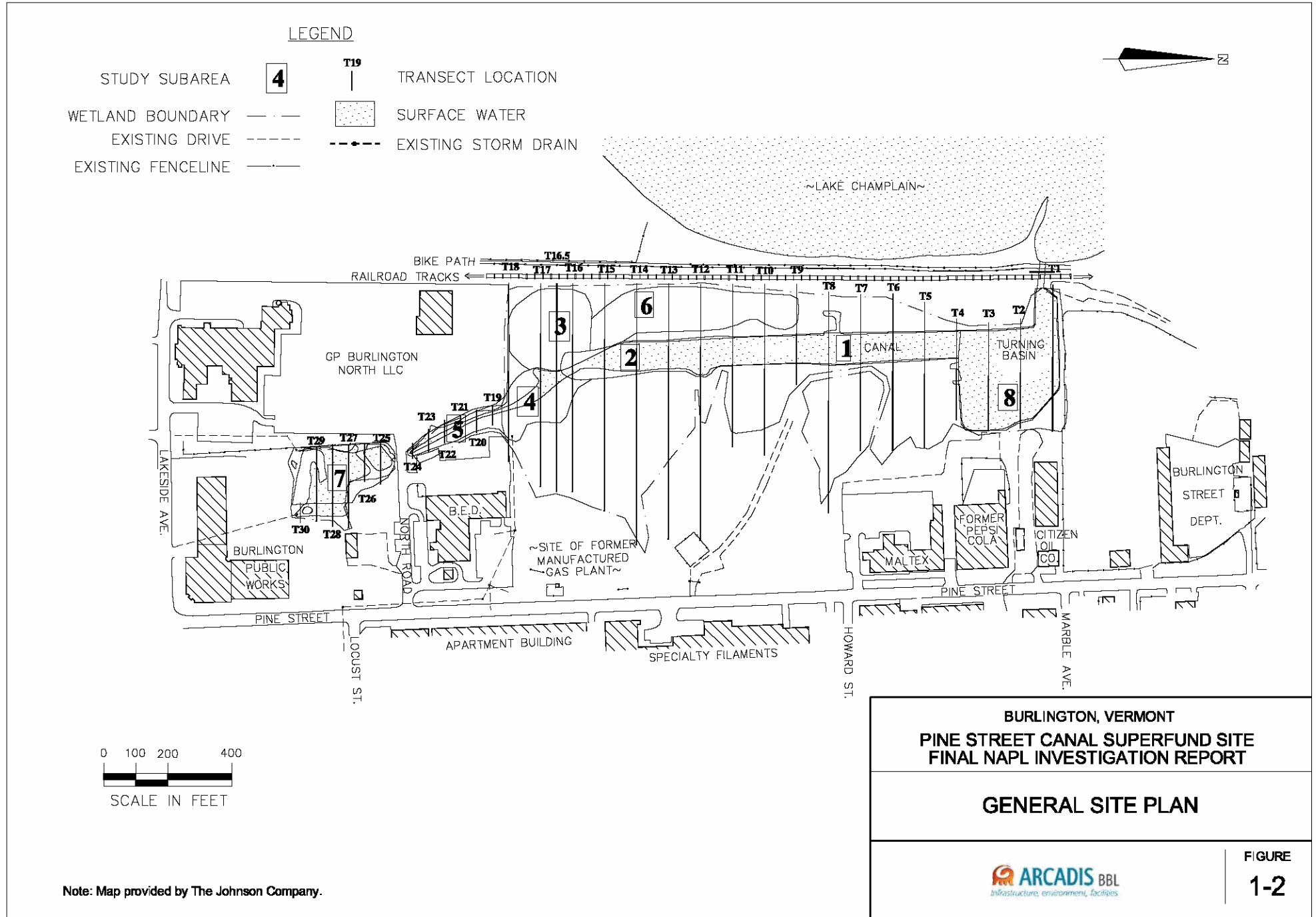


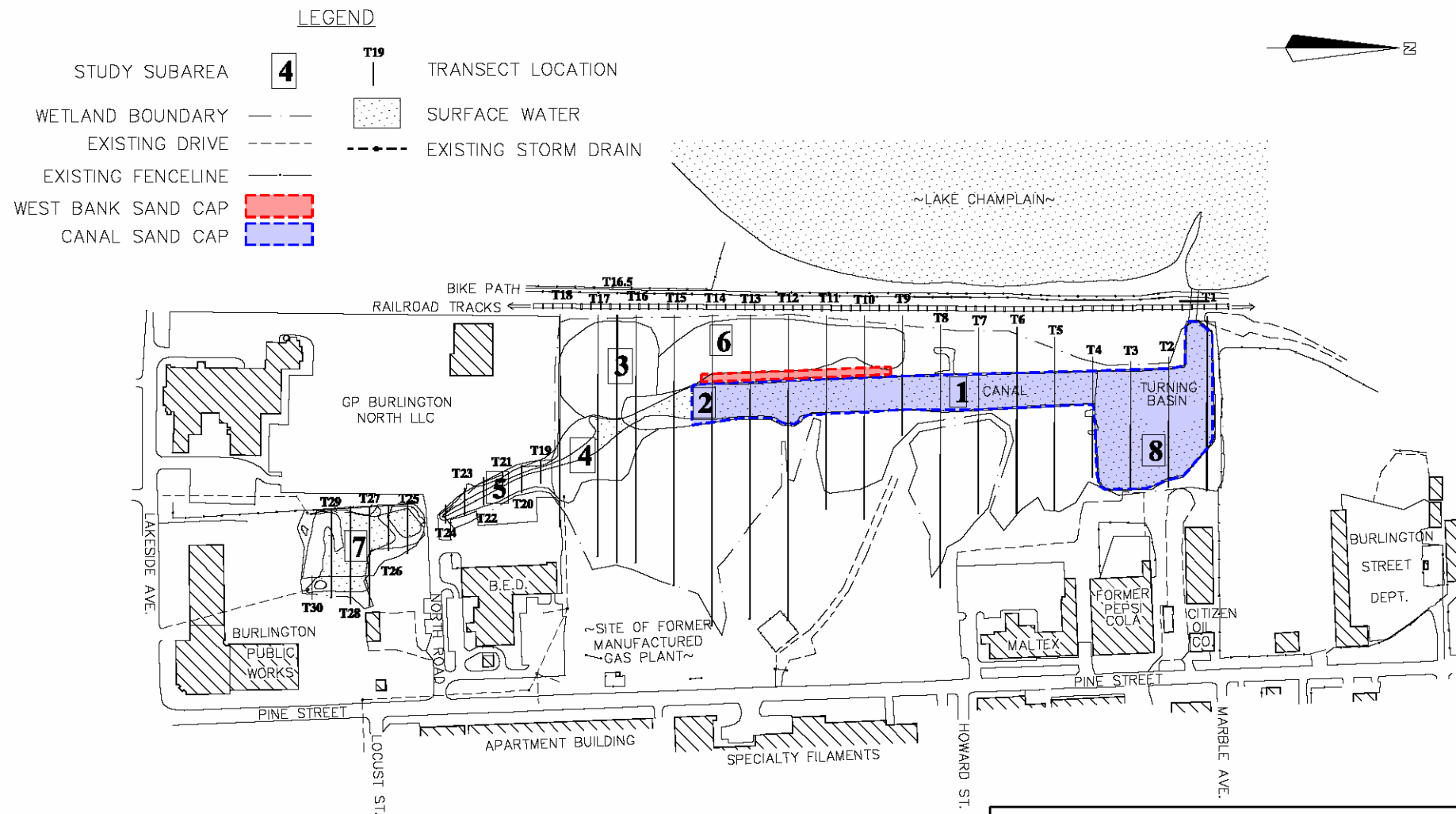
BURLINGTON, VERMONT
PINE STREET CANAL SUPERFUND SITE
FINAL NAPL INVESTIGATION REPORT

VICINITY MAP

ARCADIS BBL
Infrastructure, environment, facilities

FIGURE
1-1





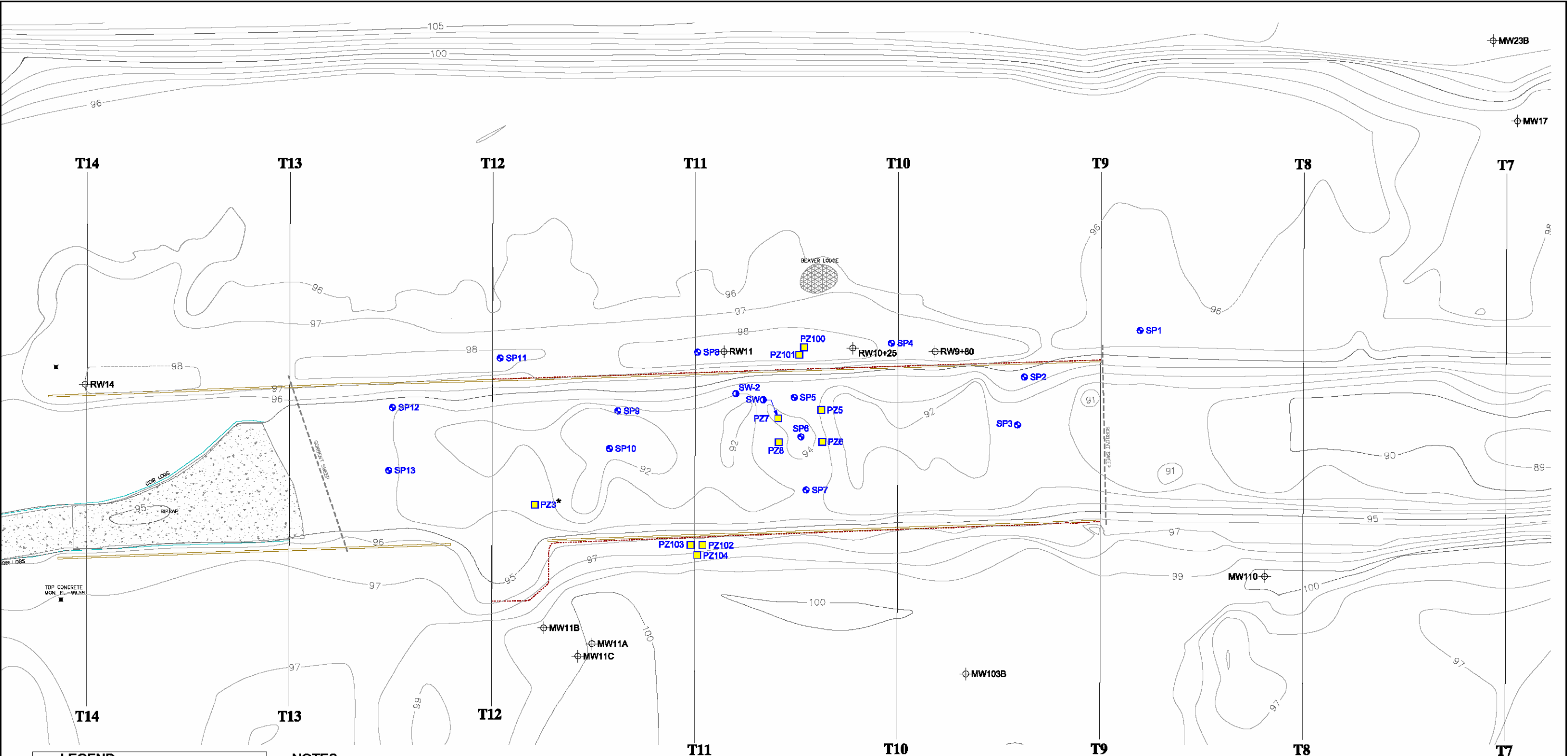
**BURLINGTON, VERMONT
 PINE STREET CANAL SUPERFUND SITE
 FINAL NAPL INVESTIGATION REPORT**

**EXTENT OF CANAL AND WEST
 BANK SAND CAPS**



**FIGURE
 1-3**

Note: Map provided by The Johnson Company.



LEGEND

- ⊕ EXISTING MONITORING WELL LOCATION
- STILLING WELL LOCATION
- PIEZOMETER LOCATION
- ⊕ SETTLEMENT PLATE LOCATION

NOTES

* GENERAL LOCATION FOR PIEZOMETERS PZ1 THROUGH PZ4 THAT WERE DAMAGED AND ABANDONED. DATA WERE COLLECTED FROM PZ3 BEFORE IT WAS DAMAGED AND ABANDONED ON JUNE 6, 2006.

SPRING EXPLORATION COMPLETED BY ARCADIS BBL ON MAY 1-24, 2006. WINTER EXPLORATION COMPLETED BY ARCADIS BBL ON FEBRUARY 1-22, 2007. PIEZOMETER SURVEY DATA BY LITTLE RIVER SURVEY COMPANY OF STOWE, VERMONT.

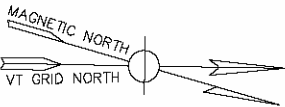
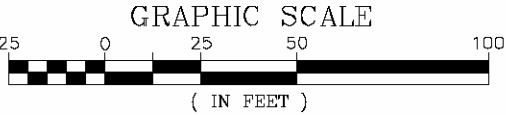
BATHYMETRIC SURVEY DATA BY THE JOHNSON COMPANY, INC. - 2005


VERTICAL & HORIZONTAL CONTROL AND TOPOGRAPHIC SURVEY BY LITTLE RIVER SURVEY COMPANY OF STOWE, VERMONT - 1992, 1994, 2000, 2003.

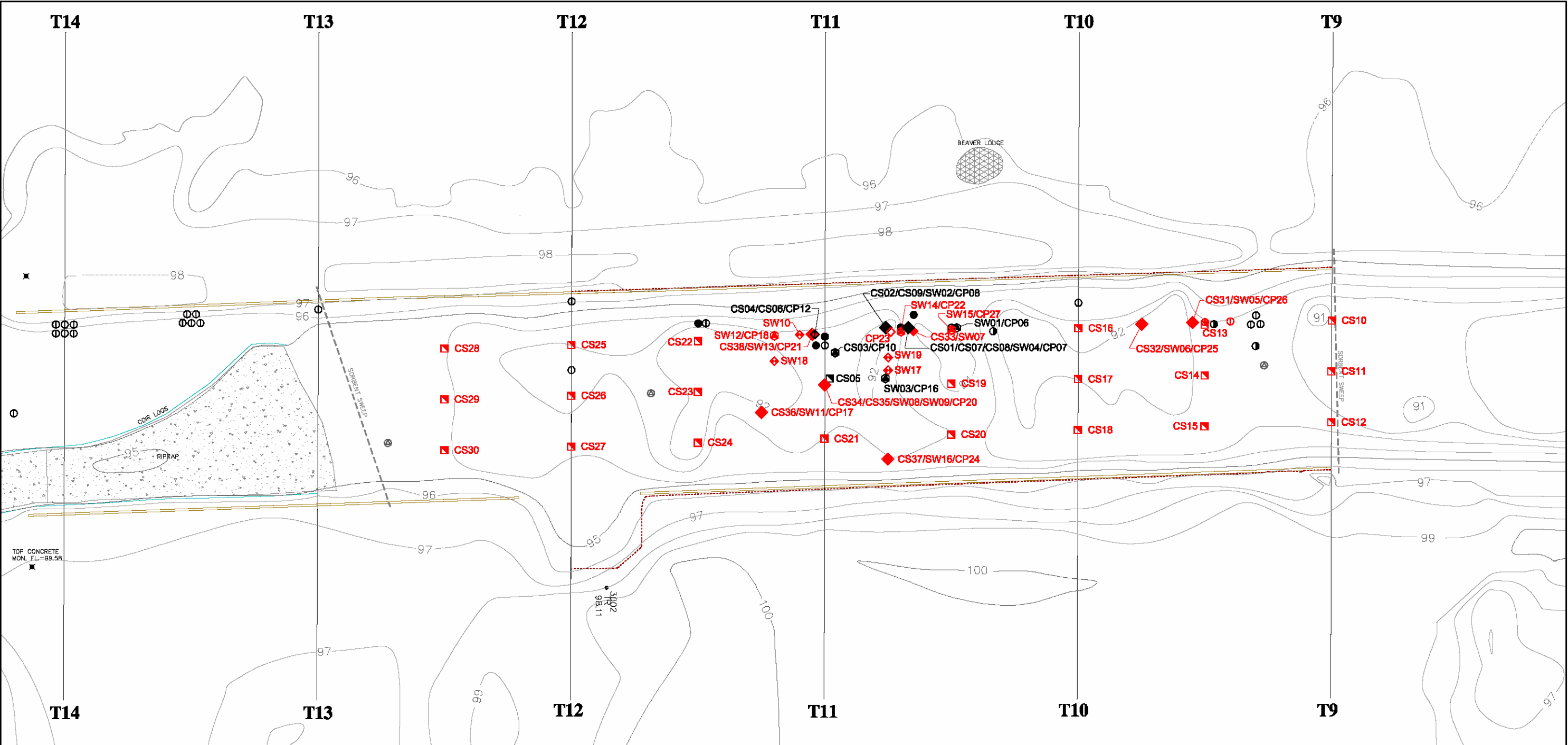
ADDITIONAL SURVEY DATA BY THE JOHNSON COMPANY, INC. - MARCH, 2003 & SUMMER, 2004.

ADDITIONAL GPS SURVEY DATA BY THE JOHNSON COMPANY, INC. - SEPTEMBER 3, 2003 & OCTOBER 26, 2004.

ADDITIONAL SOURCES: 3/92 S.R.I., 8/96 A.R.I., 5/98 A.F.S., A.R.I. Fieldbooks and 2002-2003 PSCS RA Fieldbooks 1 through 11. (Documents #337 & #408)



BURLINGTON, VERMONT PINE STREET CANAL SUPERFUND SITE FINAL NAPL INVESTIGATION REPORT	
MONITORING WELL AND PIEZOMETER LOCATIONS	
 infrastructure. environment. facilities	FIGURE 2-1



LEGEND	
SPRING	SUMMER
◆	◆
■	■
◇	◇
●	●
⊙	⊙
⊕	⊕
⊖	⊖
⊗	⊗
⊘	⊘
⊙	⊙
⊕	⊕
⊖	⊖
⊗	⊗
⊘	⊘

NOTES

SUMMER EXPLORATION COMPLETED BY ARCADIS BBL ON AUGUST 14-17, 2006.

SPRING EXPLORATION COMPLETED BY ARCADIS BBL ON MAY 1-24, 2006.

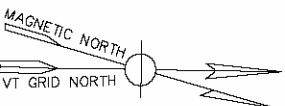
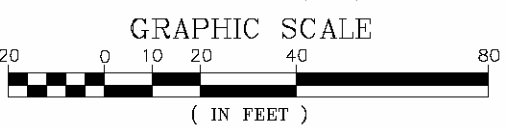
BATHYMETRIC SURVEY DATA BY THE JOHNSON COMPANY, INC. - 2005

VERTICAL & HORIZONTAL CONTROL AND TOPOGRAPHIC SURVEY BY LITTLE RIVER SURVEY COMPANY OF STOWE, VERMONT - 1992, 1994, 2000, 2003.

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BURLINGTON, VERMONT

PINE STREET CANAL SUPERFUND SITE

FINAL NAPL INVESTIGATION REPORT

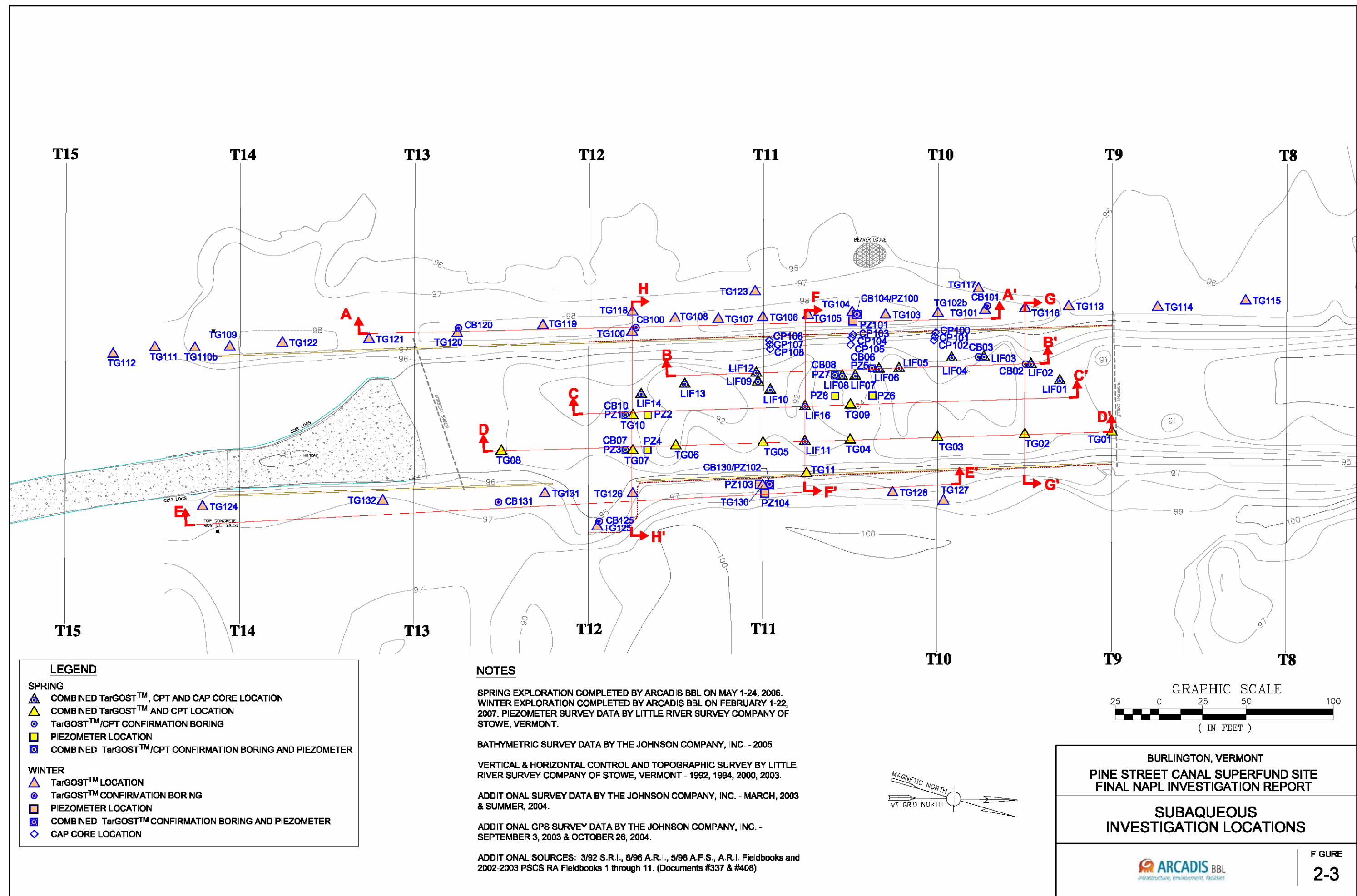
DIVER OBSERVATION

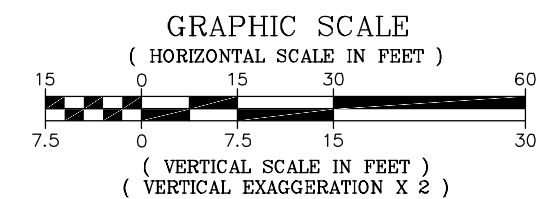
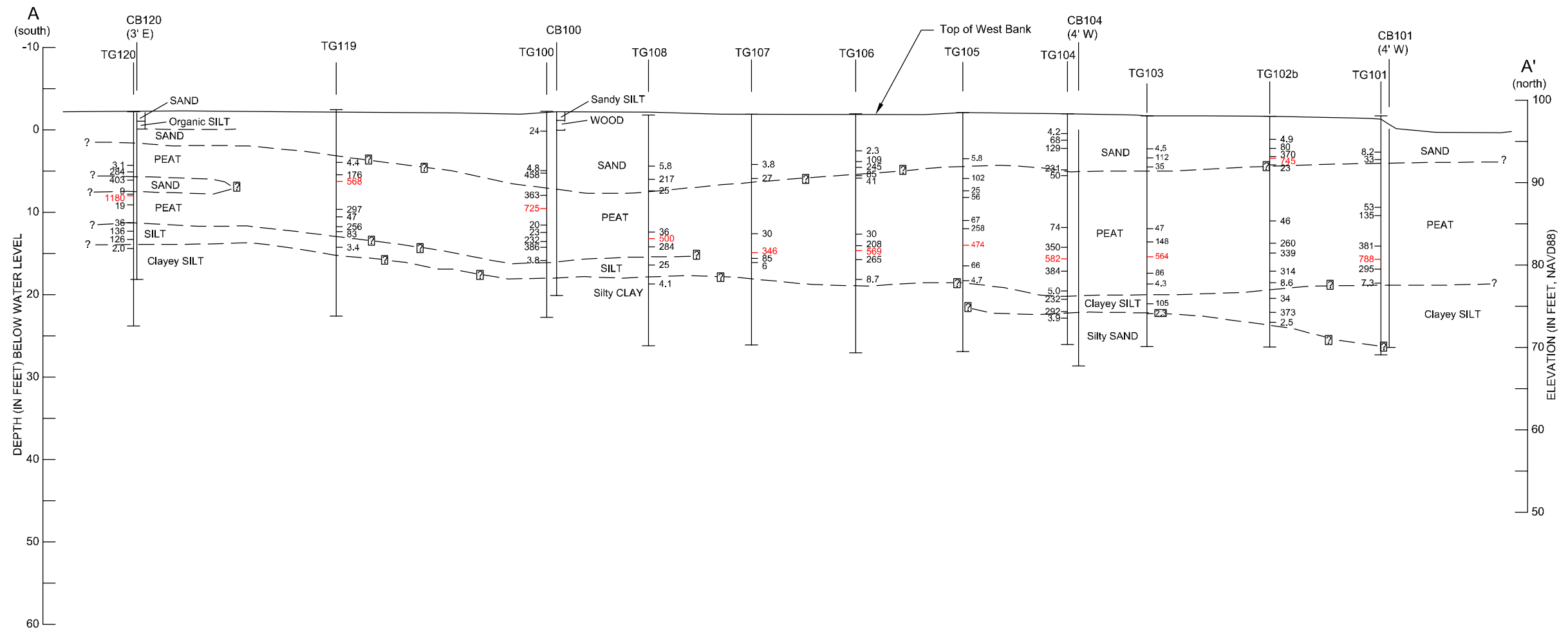
AND SAMPLING LOCATIONS

infrastructure. environment. facilities

FIGURE

2-2





NOTES:

TARGOST™ RESULTS IN UNITS OF PERCENT FLUORESCENCE.
 RESULTS IN RED SIGNIFY PEAK RESULT AT THAT LOCATION.

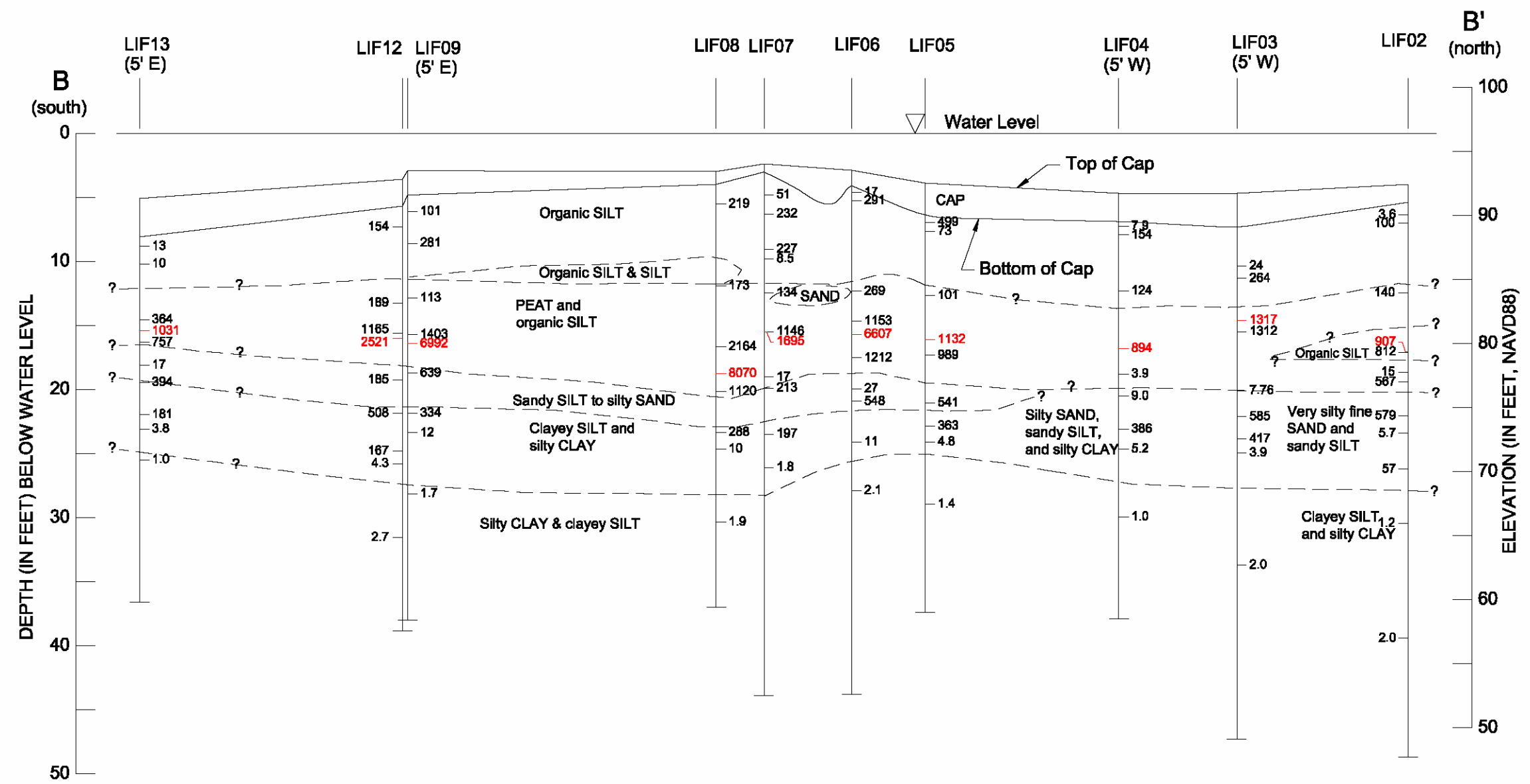
THE VERTICAL DATUM IS 1988 NORTH AMERICAN VERTICAL
 DATUM (NAVD88).

BURLINGTON, VERMONT
 PINE STREET CANAL SUPERFUND SITE
 FINAL NAPL INVESTIGATION REPORT

SECTION A-A' WEST BANK PROFILE



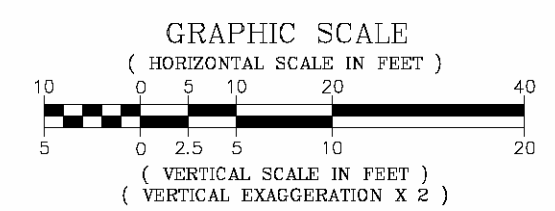
FIGURE
 3-1



NOTES:

TARGOST™ RESULTS IN UNITS OF PERCENT FLUORESCENCE.
 RESULTS IN RED SIGNIFY PEAK RESULT AT THAT LOCATION.

THE VERTICAL DATUM IS 1988 NORTH AMERICAN VERTICAL DATUM (NAVD88).



BURLINGTON, VERMONT

PINE STREET CANAL SUPERFUND SITE

FINAL NAPL INVESTIGATION REPORT

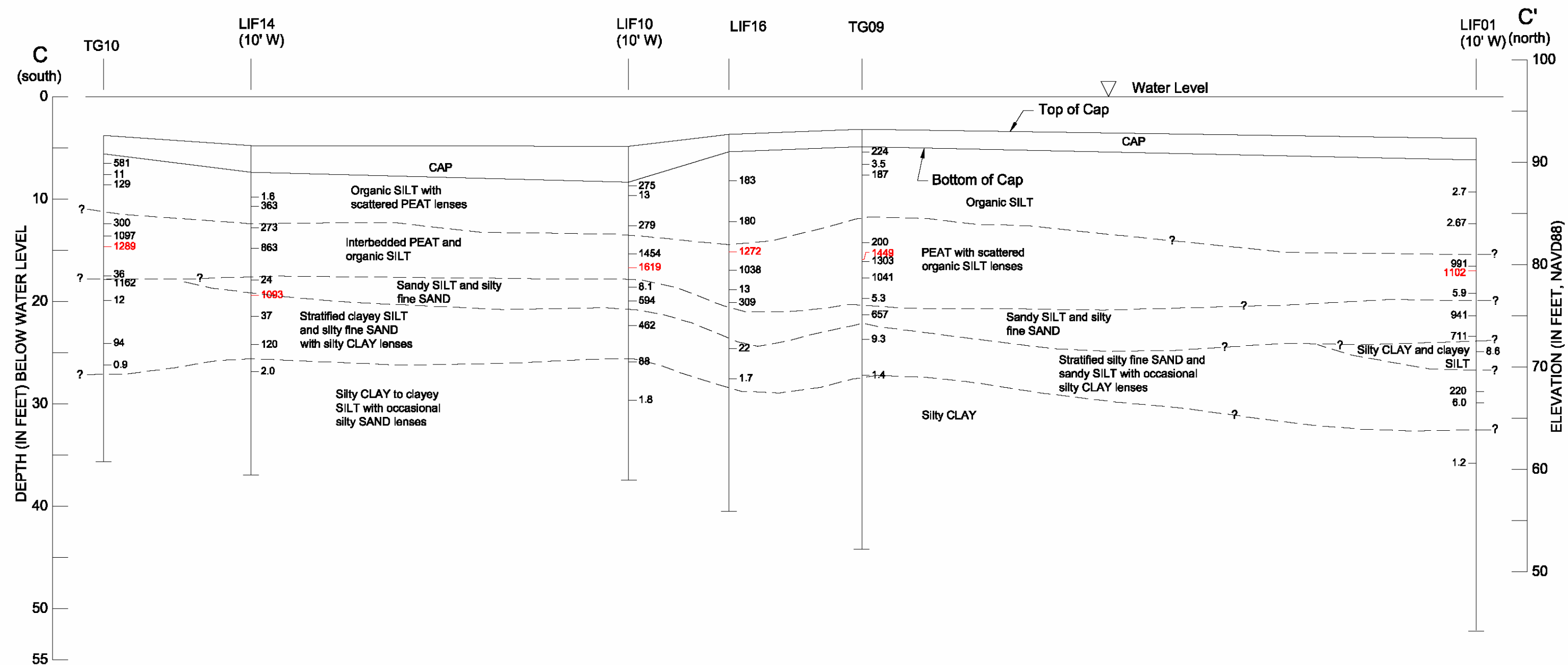
SECTION B-B'

WESTERN CANAL PROFILE

infrastructure. environment. facilities

FIGURE

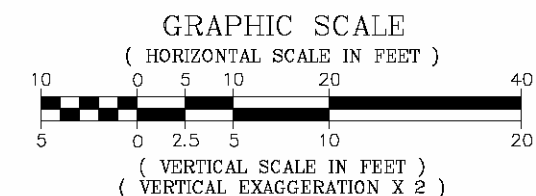
3-2



NOTES:

TARGOST™ RESULTS IN UNITS OF PERCENT FLUORESCENCE.
RESULTS IN RED SIGNIFY PEAK RESULT AT THAT LOCATION.

THE VERTICAL DATUM IS 1988 NORTH AMERICAN VERTICAL DATUM (NAVD88).

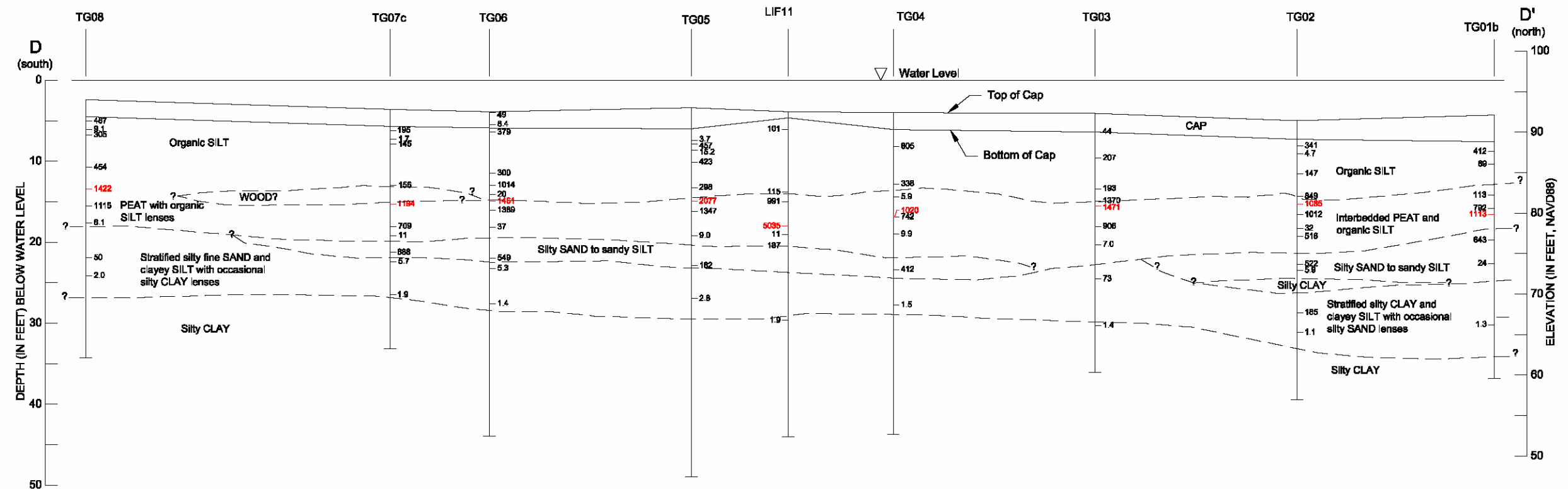


BURLINGTON, VERMONT
PINE STREET CANAL SUPERFUND SITE
FINAL NAPL INVESTIGATION REPORT

SECTION C-C'
CENTER CANAL PROFILE

ARCADIS BBL
infrastructure. environment. facilities

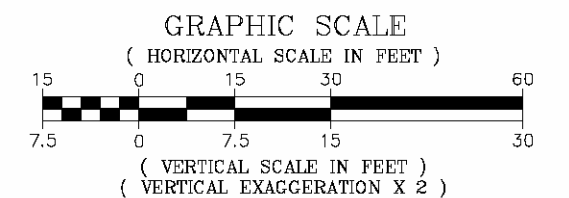
FIGURE
3-3



NOTES:

TARGOST™ RESULTS IN UNITS OF PERCENT FLUORESCENCE.
RESULTS IN **RED** SIGNIFY PEAK RESULT AT THAT LOCATION.

THE VERTICAL DATUM IS 1988 NORTH AMERICAN VERTICAL
DATUM (NAVD88).

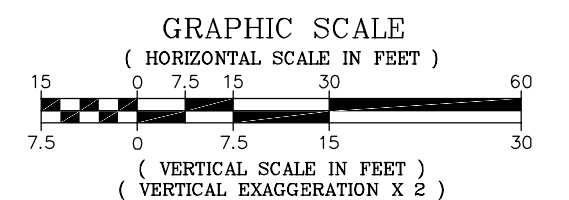
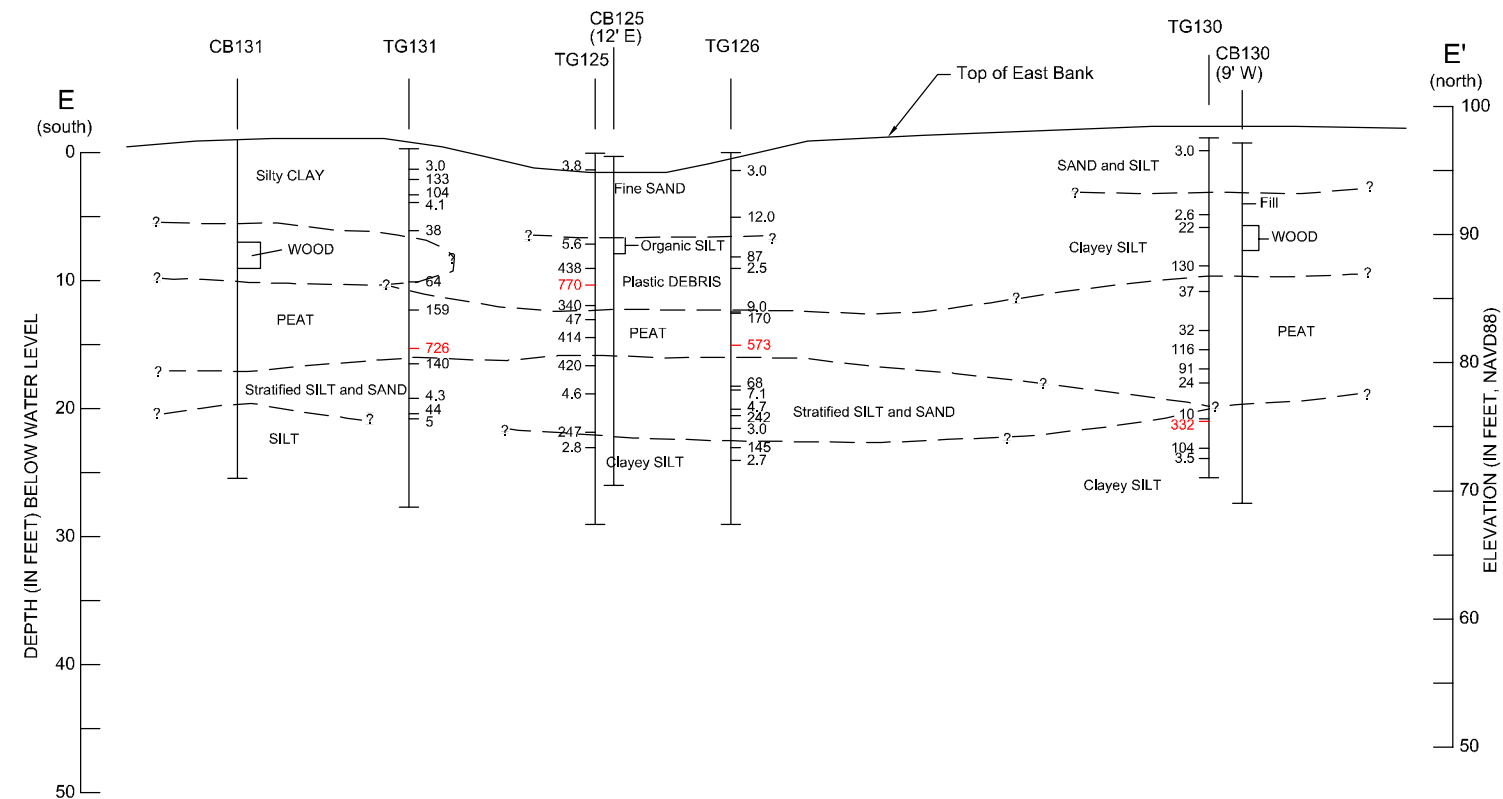


BURLINGTON, VERMONT
PINE STREET CANAL SUPERFUND SITE
FINAL NAPL INVESTIGATION REPORT

SECTION D-D'
EASTERN CANAL PROFILE

ARCADIS BBL
infrastructure, environment, facilities

FIGURE
3-4



NOTES:

TARGOST™ RESULTS IN UNITS OF PERCENT FLUORESCENCE.
 RESULTS IN **RED** SIGNIFY PEAK RESULT AT THAT LOCATION.

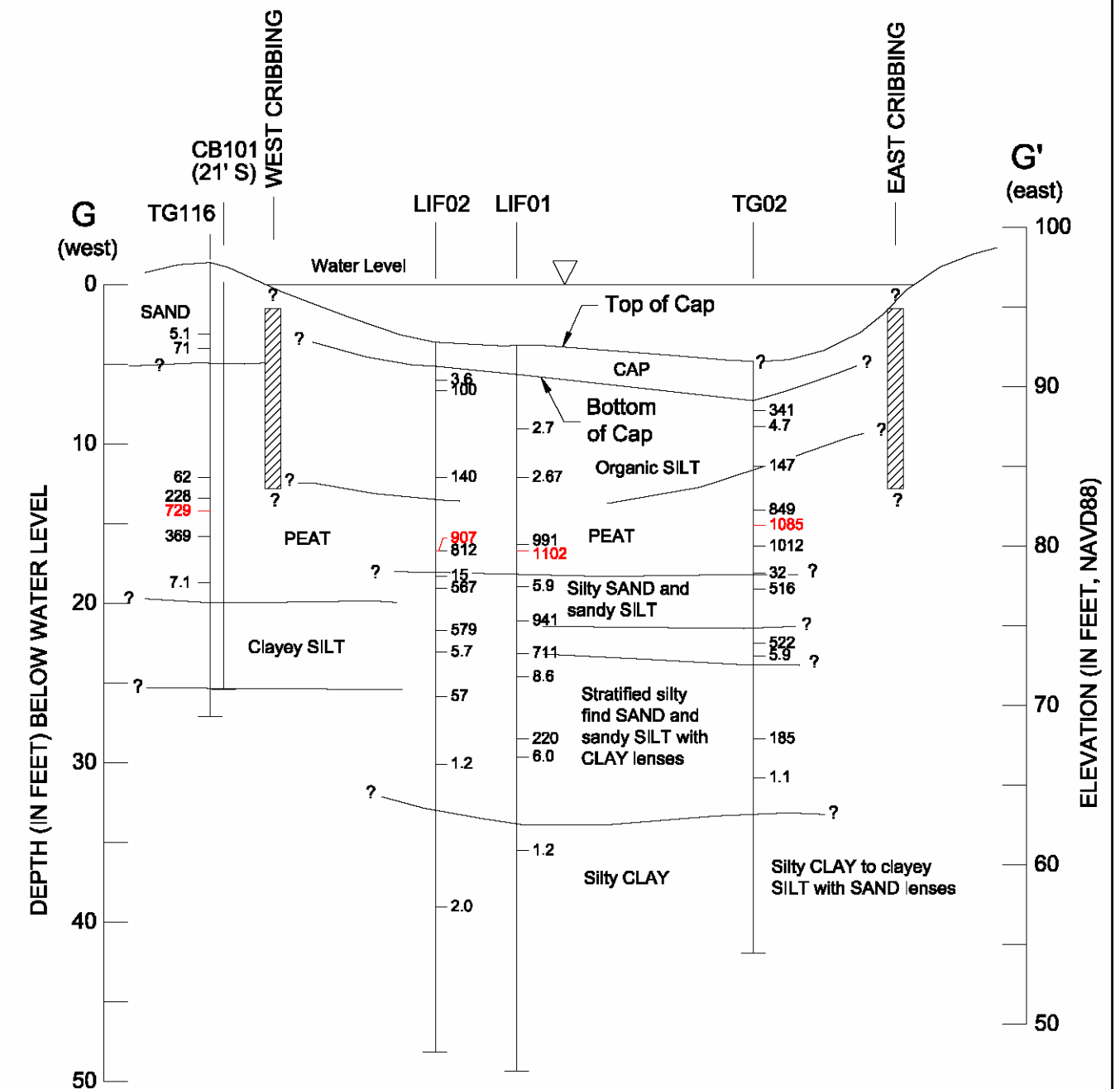
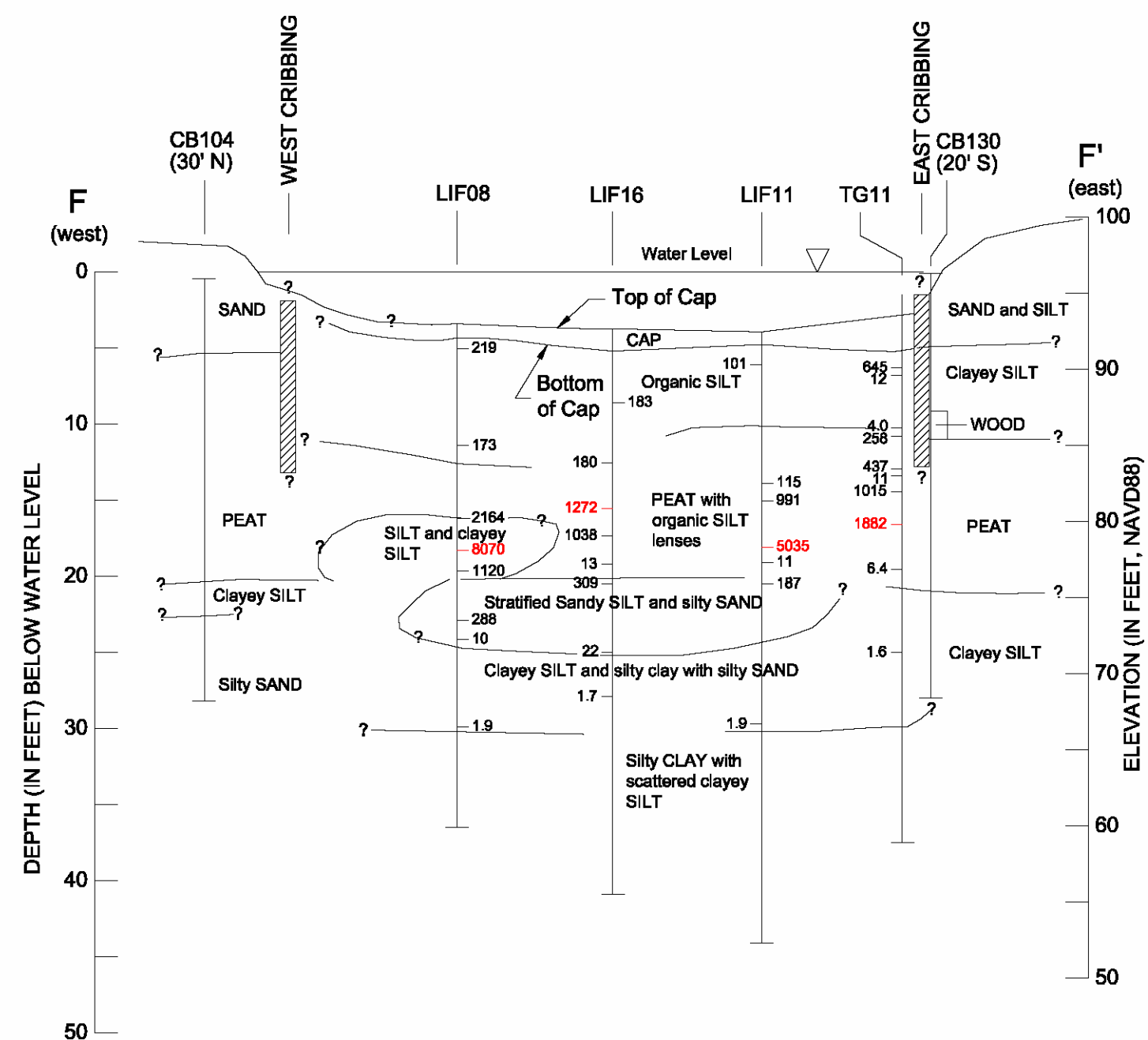
THE VERTICAL DATUM IS 1988 NORTH AMERICAN VERTICAL
 DATUM (NAVD88).

BURLINGTON, VERMONT
 PINE STREET CANAL SUPERFUND SITE
 FINAL NAPL INVESTIGATION REPORT

SECTION E-E' EAST BANK PROFILE



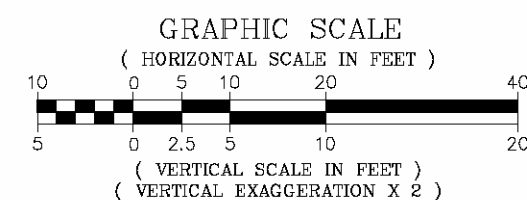
FIGURE
3-5



NOTES:

TARGOST™ RESULTS IN UNITS OF PERCENT FLUORESCENCE.
RESULTS IN RED SIGNIFY PEAK RESULT AT THAT LOCATION.

THE VERTICAL DATUM IS 1988 NORTH AMERICAN VERTICAL
DATUM (NAVD88).

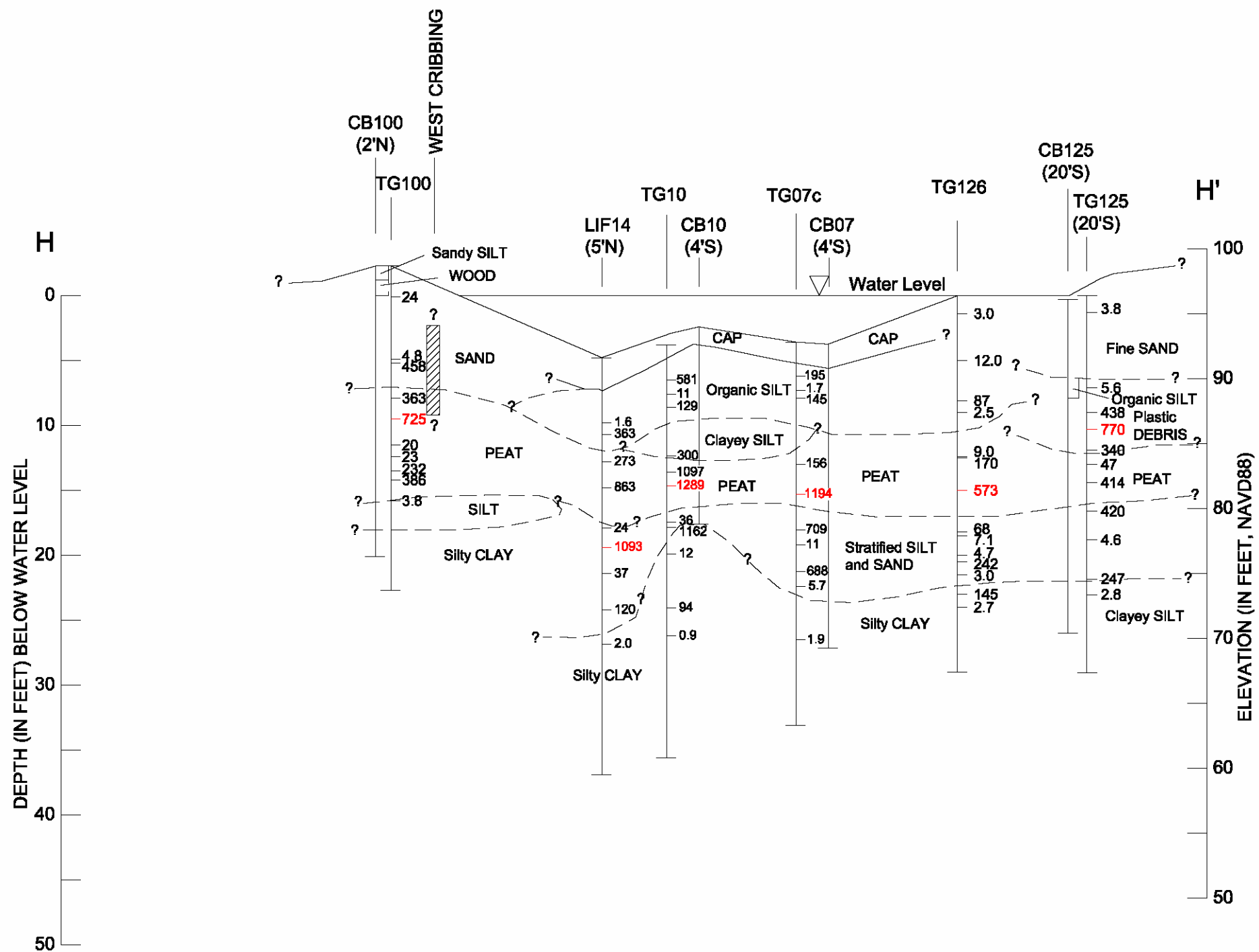


BURLINGTON, VERMONT
PINE STREET CANAL SUPERFUND SITE
FINAL NAPL INVESTIGATION REPORT

SECTIONS F-F' AND G-G'

ARCADIS BBL
infrastructure, environment, facilities

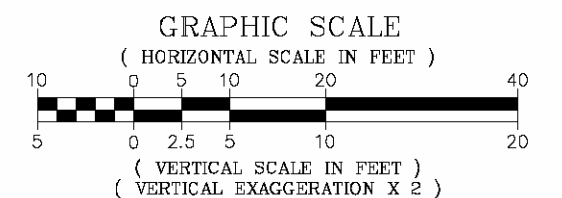
FIGURE
3-6



NOTES:

TARGOST™ RESULTS IN UNITS OF PERCENT FLUORESCENCE.
RESULTS IN **RED** SIGNIFY PEAK RESULT AT THAT LOCATION.

THE VERTICAL DATUM IS 1988 NORTH AMERICAN VERTICAL
DATUM (NAVD88).

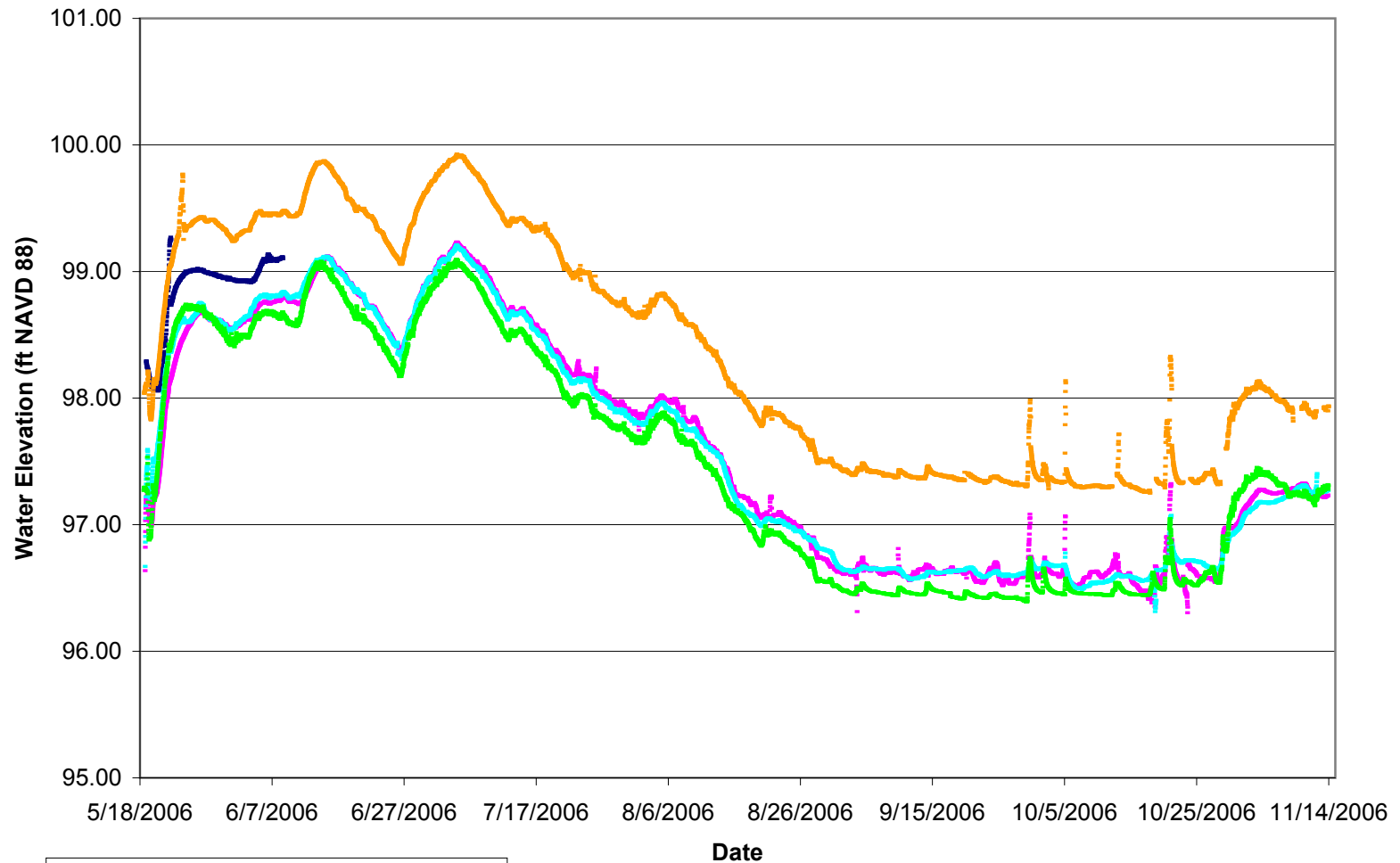


BURLINGTON, VERMONT
PINE STREET CANAL SUPERFUND SITE
FINAL NAPL INVESTIGATION REPORT

SECTION H-H'



FIGURE
3-7



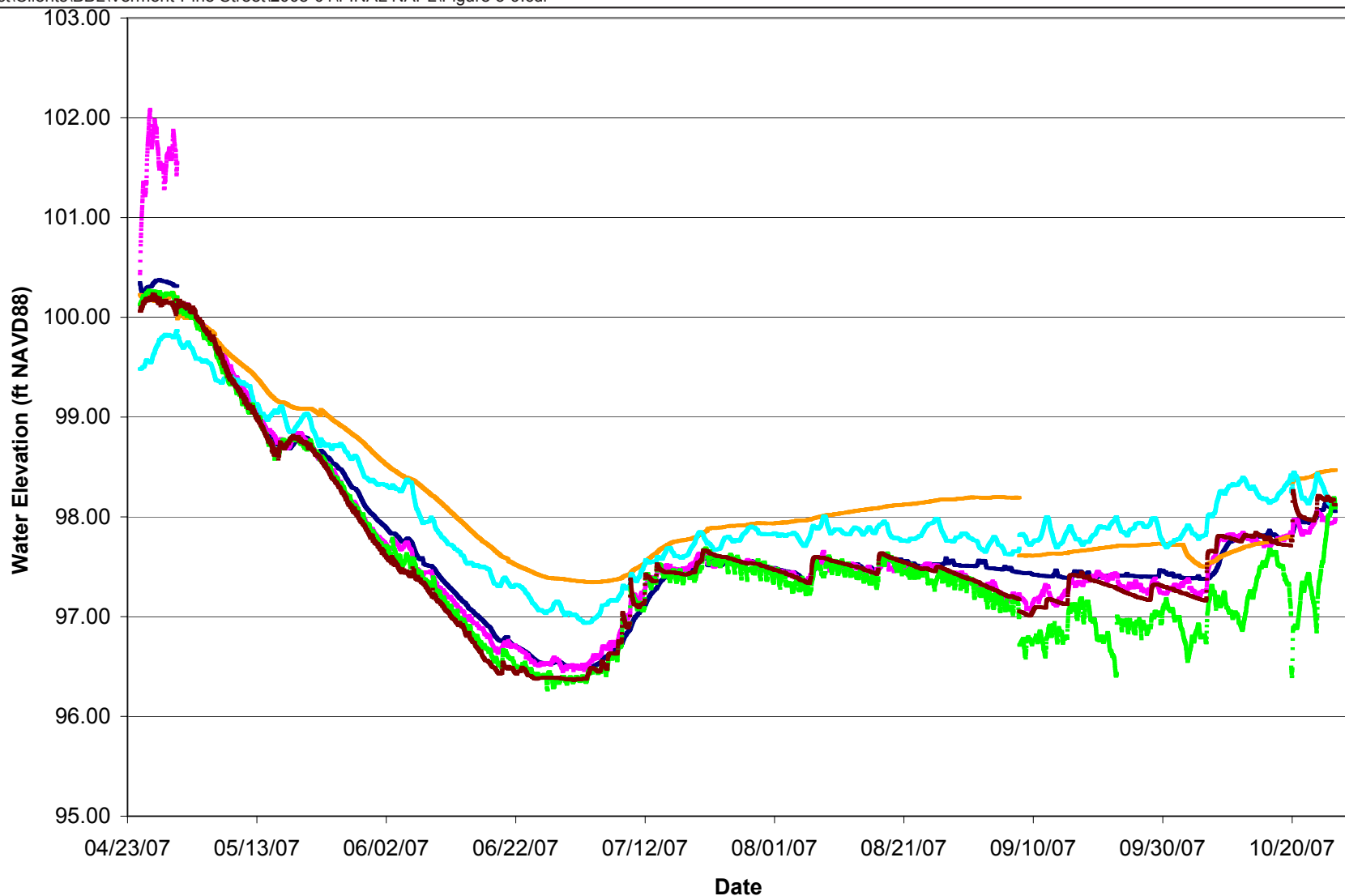
- PZ3 (Clayey Silt)
- PZ6 (Shallow Organic Silt/Sediment)
- PZ7 (Clayey Silt)
- PZ8 (Deep Organic Silt/Sediment)
- Stilling Well (Surface Water)

Note:
The vertical datum is 1988 North
American Vertical Datum (NAVD88).

BURLINGTON, VERMONT
PINE STREET CANAL SUPERFUND SITE
FINAL NAPL INVESTIGATION REPORT
2006 PIEZOMETER GROUNDWATER
ELEVATION DATA



FIGURE
3-8



- PZ-100 (WB strat silt/sand)
- PZ-101 (WB peat)
- PZ-102 (EB clayey silt)
- PZ-103 (EB peat)
- PZ-104 (EB peat)
- stilling well

Screened Intervals (ft NAVD88)

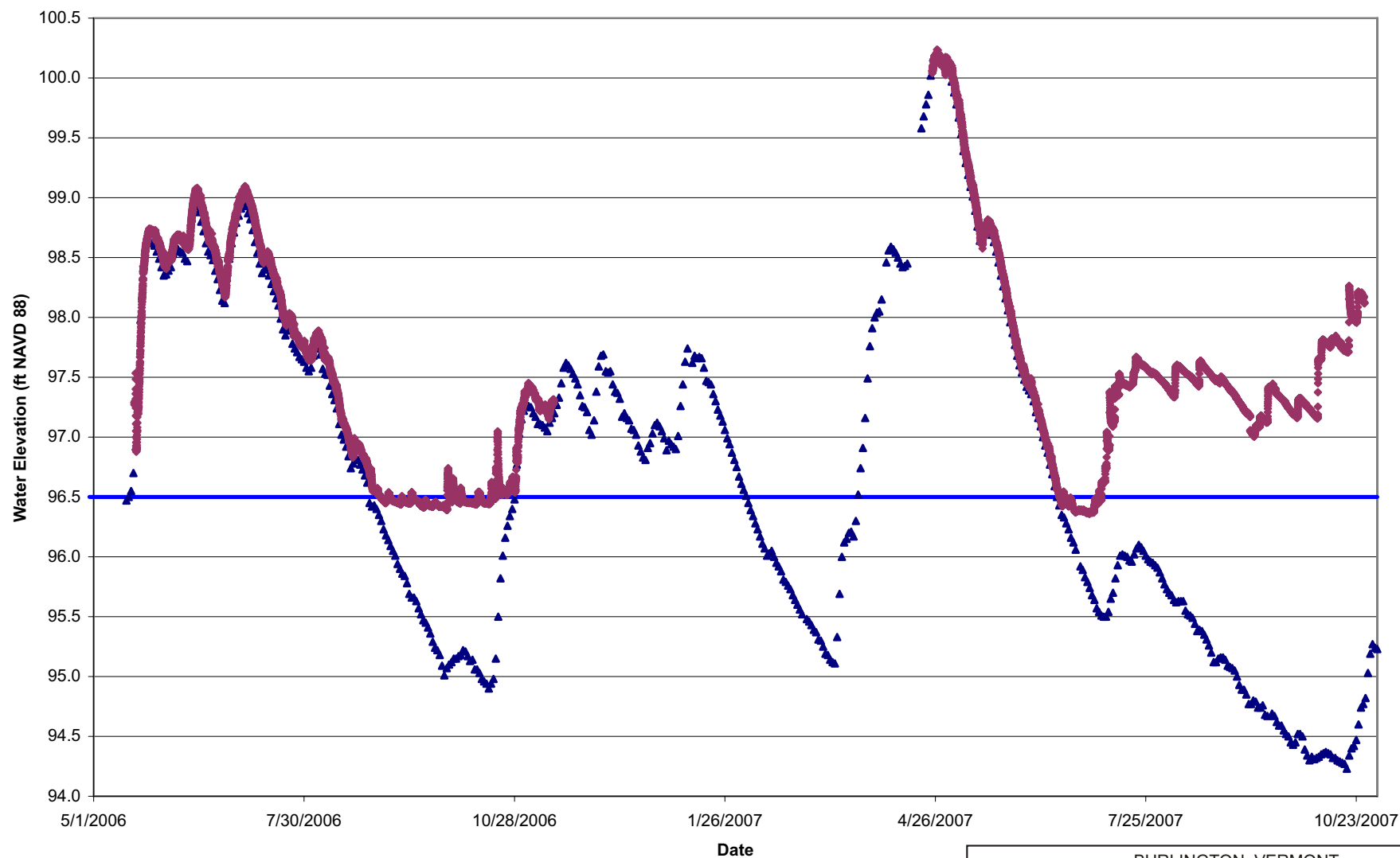
PZ-100 71.78 to 72.43
 PZ-101 85.65 to 86.30
 PZ-102 70.64 to 71.29
 PZ-103 80.55 to 81.20
 PZ-104 90.79 to 91.44

Note:
 The vertical datum is 1988 North
 American Vertical Datum (NAVD88).

BURLINGTON, VERMONT
 PINE STREET CANAL SUPERFUND SITE
 FINAL NAPL INVESTIGATION REPORT
 2007 PIEZOMETER GROUNDWATER
 ELEVATION DATA



FIGURE
 3-9



- ▲ Lake Champlain Water Level
- ◆ Pine Street Canal Water Level
- Top of Weir

Notes:

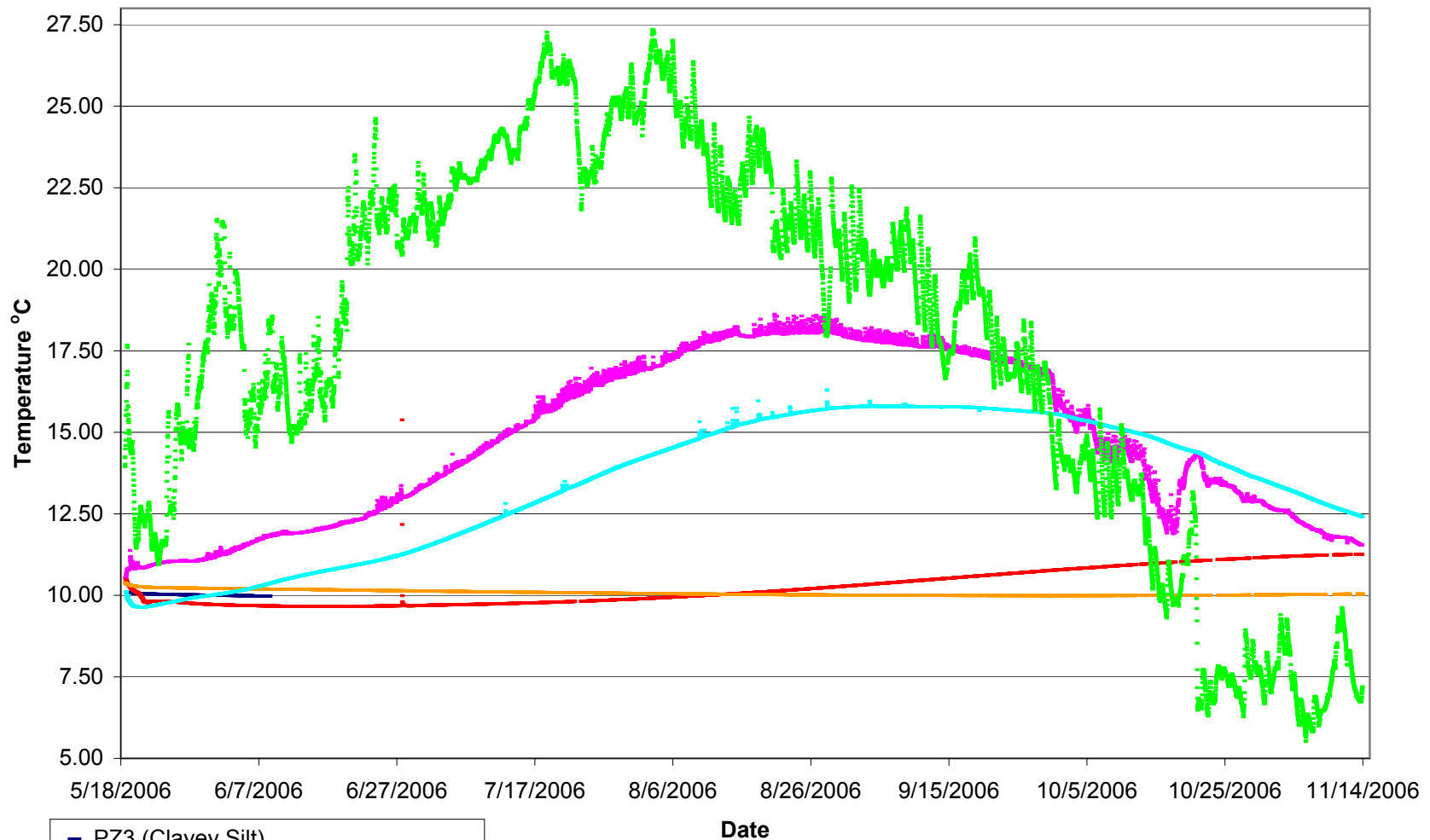
Lake Champlain water level measured at USGS Lake Gauging Station #04294500.

The vertical datum is 1988 North American Vertical Datum (NAVD88).

BURLINGTON, VERMONT
PINE STREET CANAL SUPERFUND SITE
FINAL NAPL INVESTIGATION REPORT
2006 AND 2007 SURFACE WATER
ELEVATION DATA



FIGURE
3-10



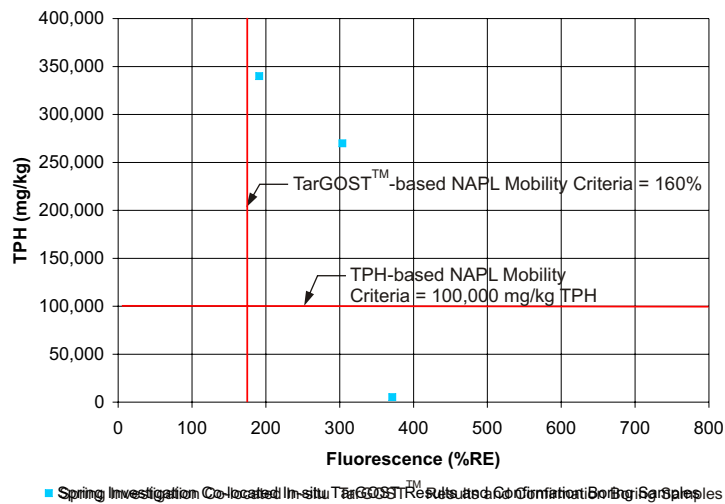
- PZ3 (Clayey Silt)
- PZ5 (Peat)
- PZ6 (Shallow Organic Silt/Sediment)
- PZ7 (Clayey Silt)
- PZ8 (Deep Organic Silt/Sediment)
- Stilling Well (Surface)

Note:
The vertical datum is 1988 North
American Vertical Datum (NAVD88).

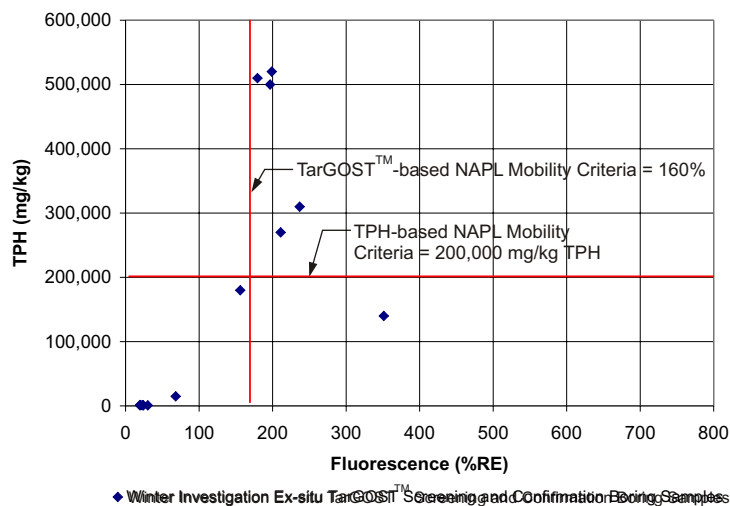
BURLINGTON, VERMONT
PINE STREET CANAL SUPERFUND SITE
FINAL NAPL INVESTIGATION REPORT
2006 PIEZOMETER GROUNDWATER
TEMPERATURE DATA



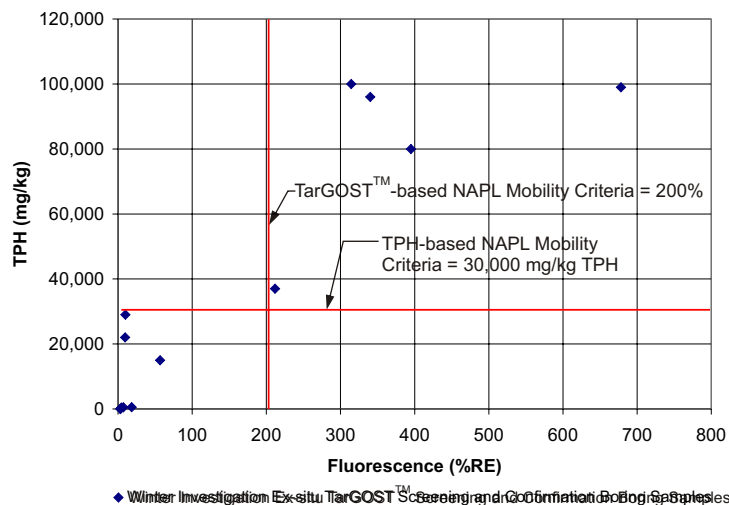
FIGURE
3-11



ORGANIC SILT/ SEDIMENT SAMPLES



PEAT SAMPLES



STRATIFIED SILT AND SAND SAMPLES

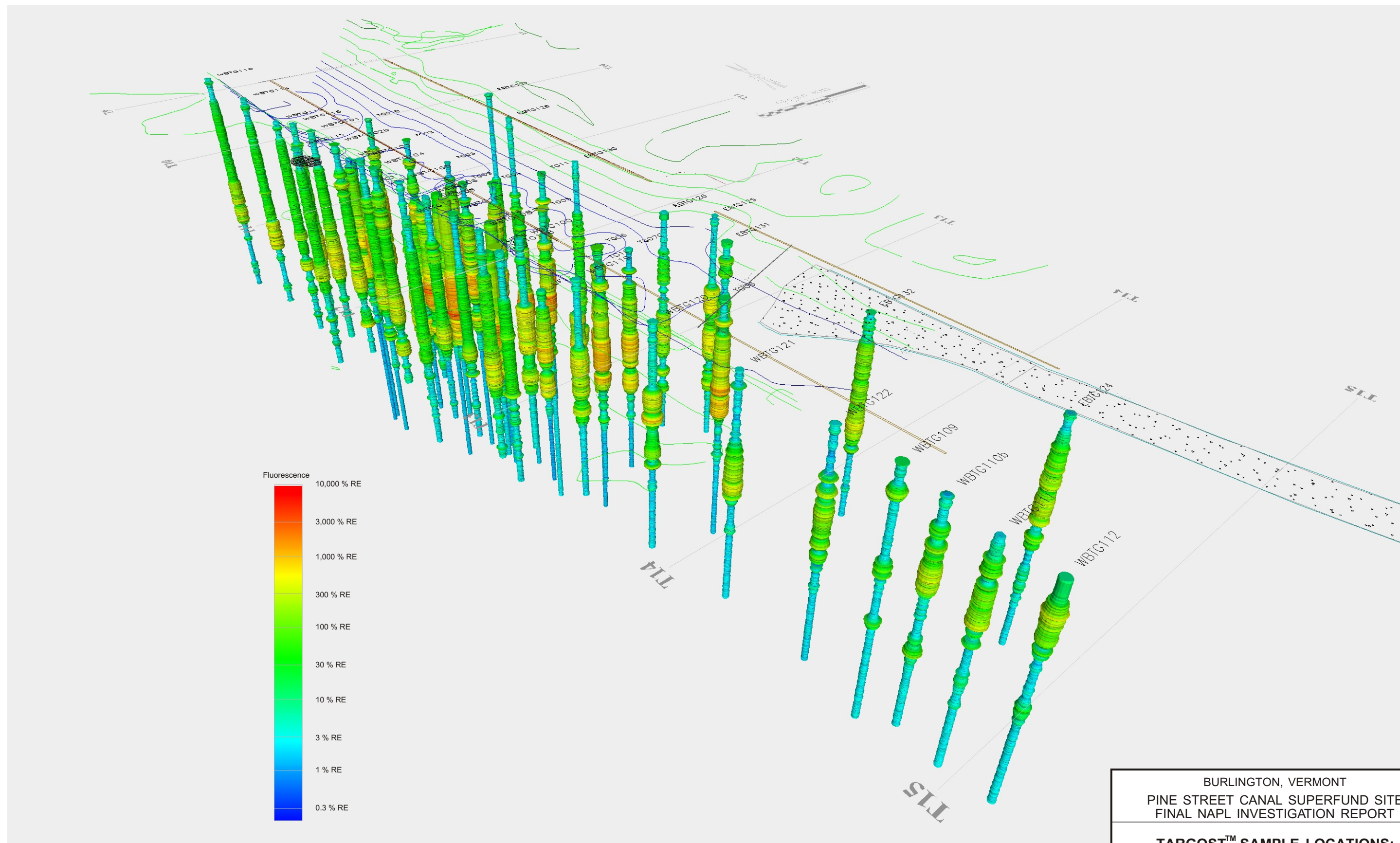
BURLINGTON, VERMONT
PINE STREET CANAL SUPERFUND SITE
FINAL NAPL INVESTIGATION REPORT

TPH-BASED AND TarGOST™-BASED
NAPL MOBILITY CRITERIA



FIGURE

4-1

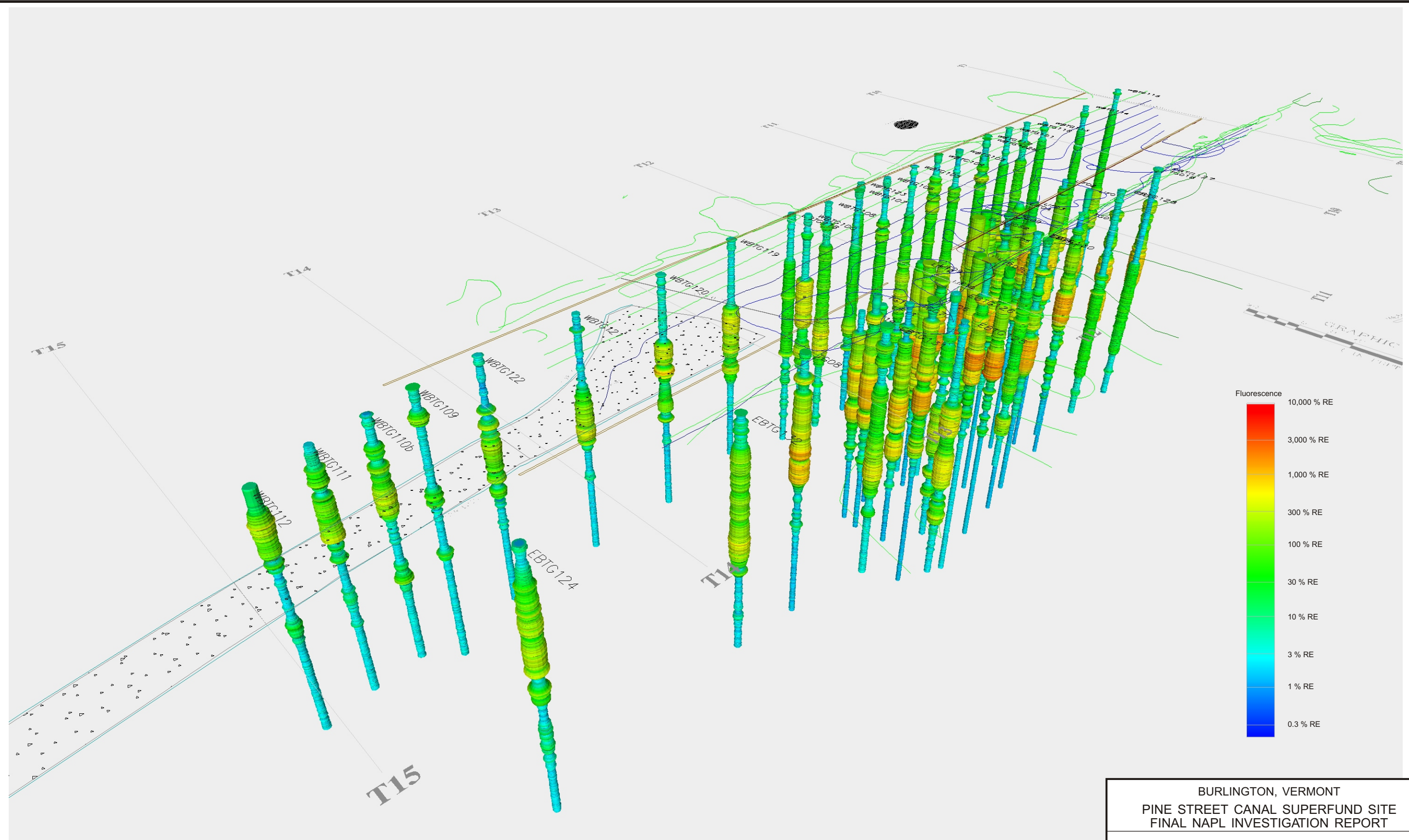


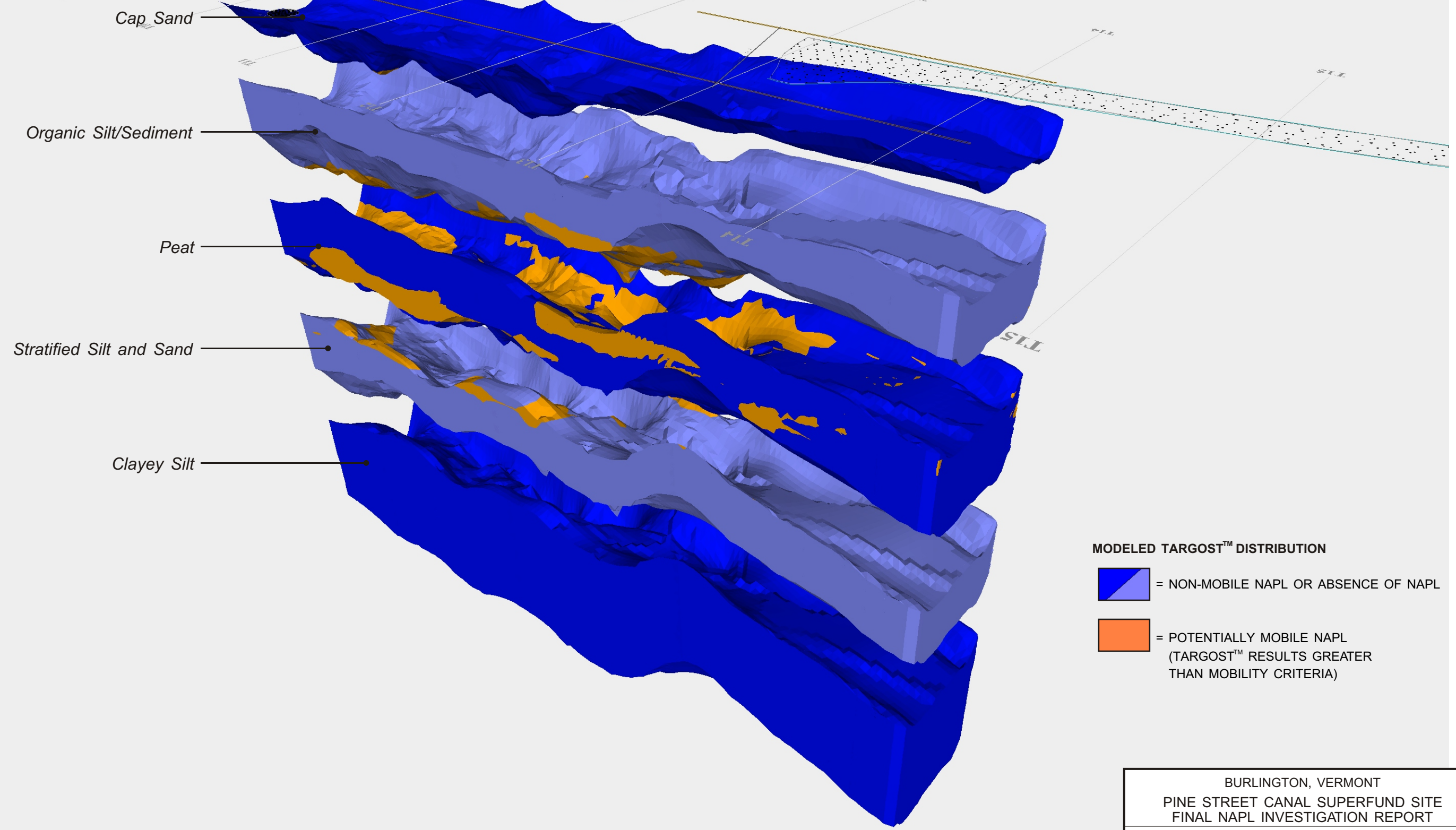
BURLINGTON, VERMONT
PINE STREET CANAL SUPERFUND SITE
FINAL NAPL INVESTIGATION REPORT

**TARGOST™ SAMPLE LOCATIONS:
OBLIQUE VIEW FROM THE SOUTHWEST**

ARCADIS BBL
Infrastructure, environment, facilities

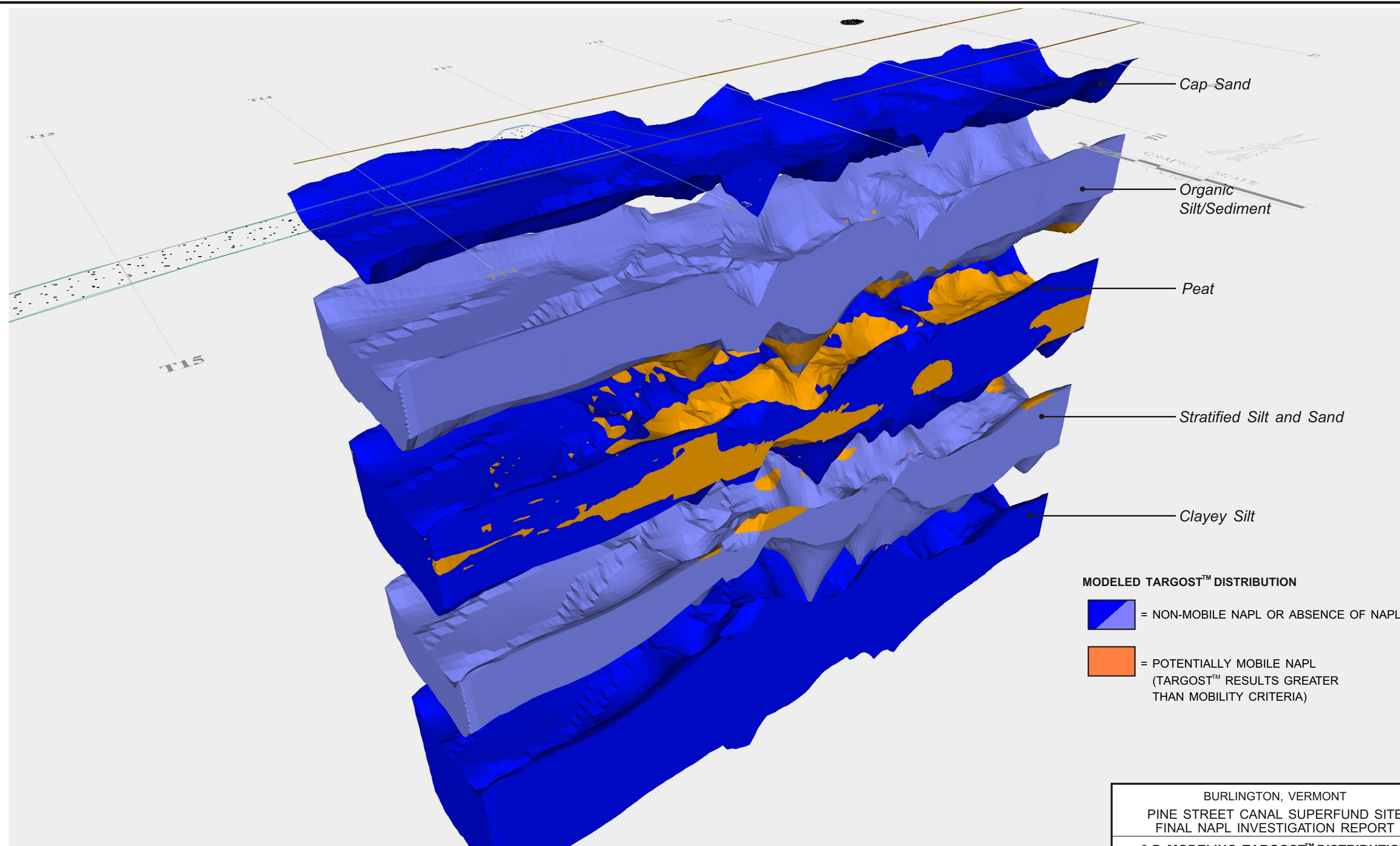
FIGURE
4-2





BURLINGTON, VERMONT
PINE STREET CANAL SUPERFUND SITE
FINAL NAPL INVESTIGATION REPORT

**3-D MODELING TARGOST™ DISTRIBUTION
IN STRATIGRAPHIC UNITS:
VIEW FROM THE SOUTHWEST**

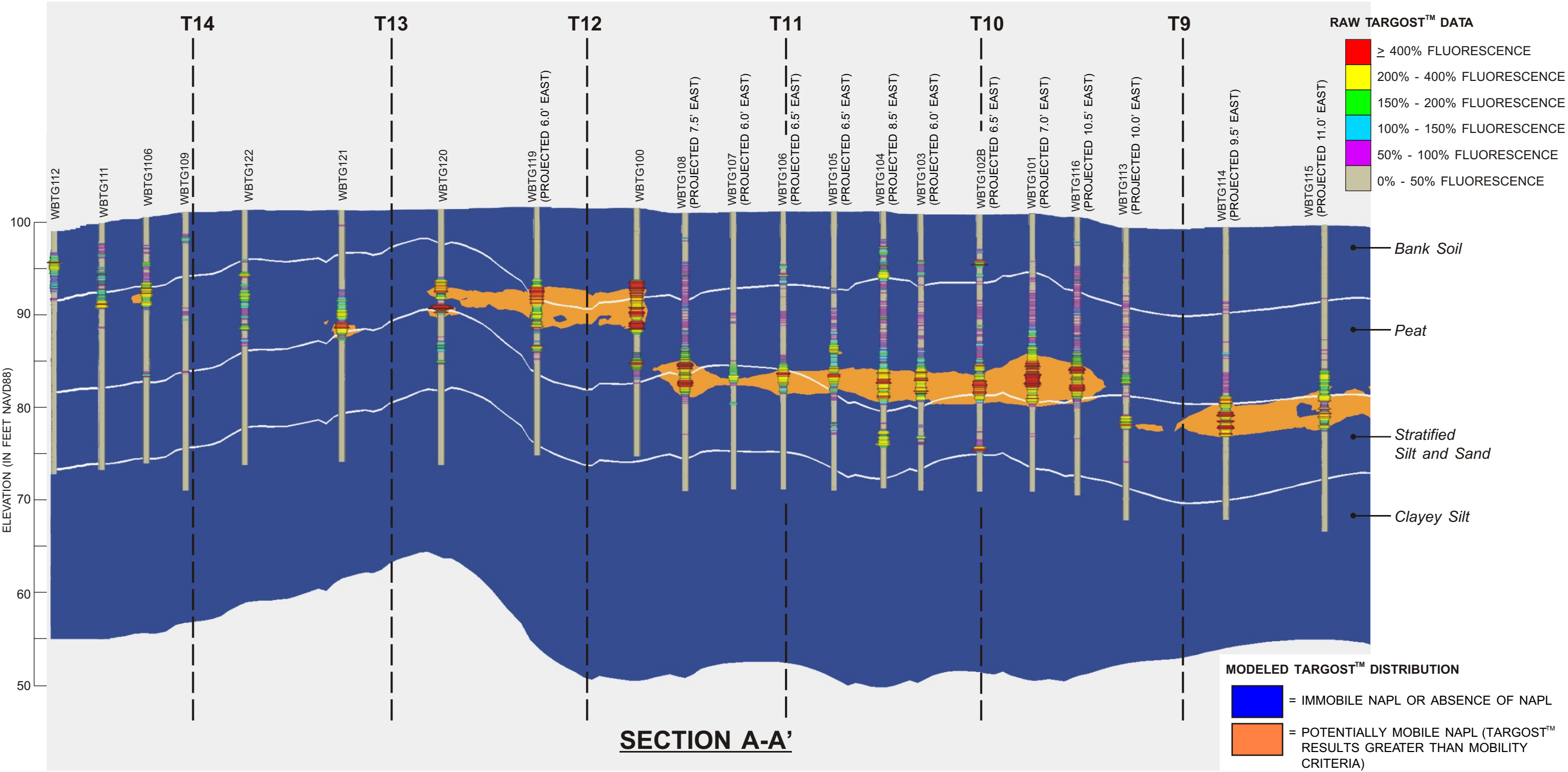


BURLINGTON, VERMONT
PINE STREET CANAL SUPERFUND SITE
FINAL NAPL INVESTIGATION REPORT

**3-D MODELING TARGOST™ DISTRIBUTION
IN STRATIGRAPHIC UNITS:
VIEW FROM THE SOUTHEAST**

SOUTH

NORTH

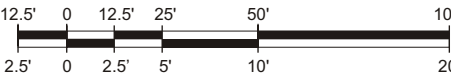


NOTES:
THIS DISTRIBUTION IS BASED ON THE 3-D MODEL AND MAY NOT REFLECT IN-SITU CONDITIONS

THE VERTICAL DATUM IS 1988 NORTH AMERICAN VERTICAL DATUM (NAVD88)

STRATIGRAPHY BETWEEN WB TG101 AND WB TG120 WAS DEVELOPED FROM CONFIRMATION BORINGS ALONG THE WEST BANK. STRATIGRAPHY NORTH OF WB TG101 AND SOUTH OF WB TG120 WAS EXTRAPOLATED FOR PURPOSES OF DEVELOPING THE 3-D MODEL.

APPROXIMATE GRAPHIC SCALE
(HORIZONTAL SCALE IN FEET)



(VERTICAL SCALE IN FEET)
(VERTICAL EXAGGERATION X 5)

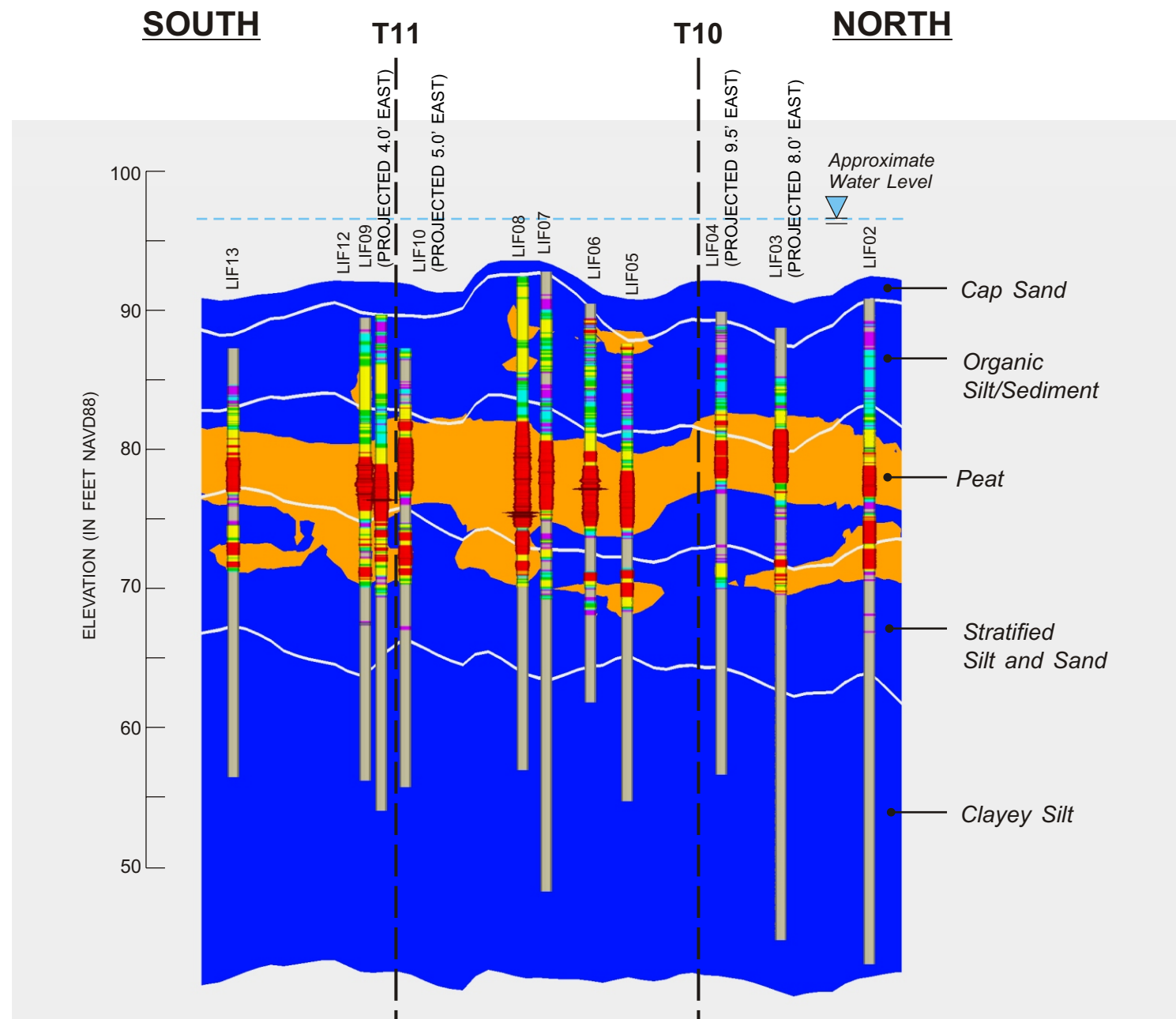
BURLINGTON, VERMONT
PINE STREET CANAL SUPERFUND SITE
FINAL NAPL INVESTIGATION REPORT

**3-D MODELING TARGOST™
DISTRIBUTION AND RAW TARGOST™:
SECTION A-A'**

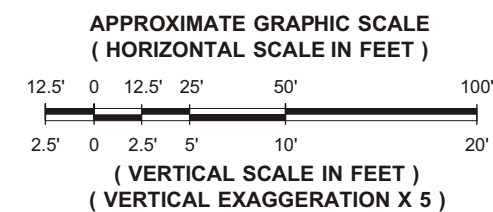
ARCADIS BBL
Infrastructure, environment, facilities

**FIGURE
4-6**



01/15/08 SYR-D85-DJH
B0069852/0000/00009/CDR/69852G01.CDR









SECTION B-B'



MODELED TARGOST™ DISTRIBUTION

-  = IMMOBILE NAPL OR ABSENCE OF NAPL
-  = POTENTIALLY MOBILE NAPL (TARGOST™ RESULTS GREATER THAN MOBILITY CRITERIA)

RAW TARGOST™ DATA

-  ≥ 400% FLUORESCENCE
-  200% - 400% FLUORESCENCE
-  150% - 200% FLUORESCENCE
-  100% - 150% FLUORESCENCE
-  50% - 100% FLUORESCENCE
-  0% - 50% FLUORESCENCE

NOTES:
THIS DISTRIBUTION IS BASED ON THE 3-D MODEL AND MAY NOT REFLECT IN-SITU CONDITIONS

THE VERTICAL DATUM IS 1988 NORTH AMERICAN VERTICAL DATUM (NAVD88)

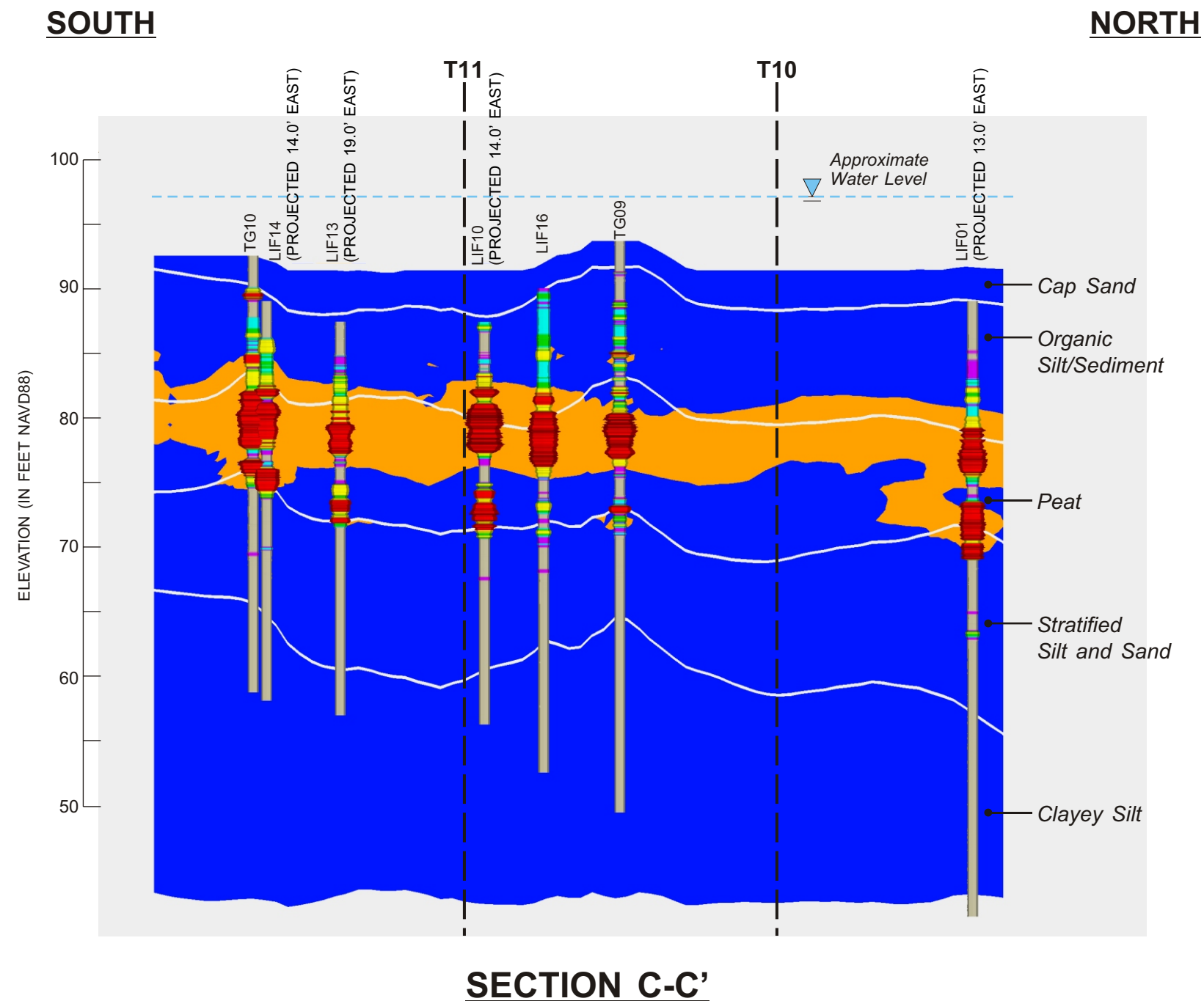
APPROXIMATE WATER LEVEL IS BASED ON WATER ELEVATION DURING THE 2006 SPRING INVESTIGATION AND IS INTENDED FOR ILLUSTRATION PURPOSES ONLY.

BURLINGTON, VERMONT
PINE STREET CANAL SUPERFUND SITE
FINAL NAPL INVESTIGATION REPORT

**3-D MODELING TARGOST™
DISTRIBUTION AND RAW TARGOST™:
SECTION B-B'**


Infrastructure, environment, facilities

**FIGURE
4-7**



MODELED TARGOST™ DISTRIBUTION

= IMMOBILE NAPL OR ABSENCE OF NAPL

= POTENTIALLY MOBILE NAPL (TARGOST™ RESULTS GREATER THAN MOBILITY CRITERIA)

RAW TARGOST™ DATA

	≥ 400% FLUORESCENCE
	200% - 400% FLUORESCENCE
	150% - 200% FLUORESCENCE
	100% - 150% FLUORESCENCE
	50% - 100% FLUORESCENCE
	0% - 50% FLUORESCENCE

- NOTES:**
1. THIS DISTRIBUTION IS BASED ON THE 3-D MODEL AND MAY NOT REFLECT IN-SITU CONDITIONS
 2. THE VERTICAL DATUM IS 1988 NORTH AMERICAN VERTICAL DATUM (NAVD88)
 3. APPROXIMATE WATER LEVEL IS BASED ON WATER ELEVATION DURING THE 2006 SPRING INVESTIGATION AND IS INTENDED FOR ILLUSTRATION PURPOSES ONLY.

APPROXIMATE GRAPHIC SCALE
(HORIZONTAL SCALE IN FEET)

12.5' 0 12.5' 25' 50' 100'

2.5' 0 2.5' 5' 10' 20'

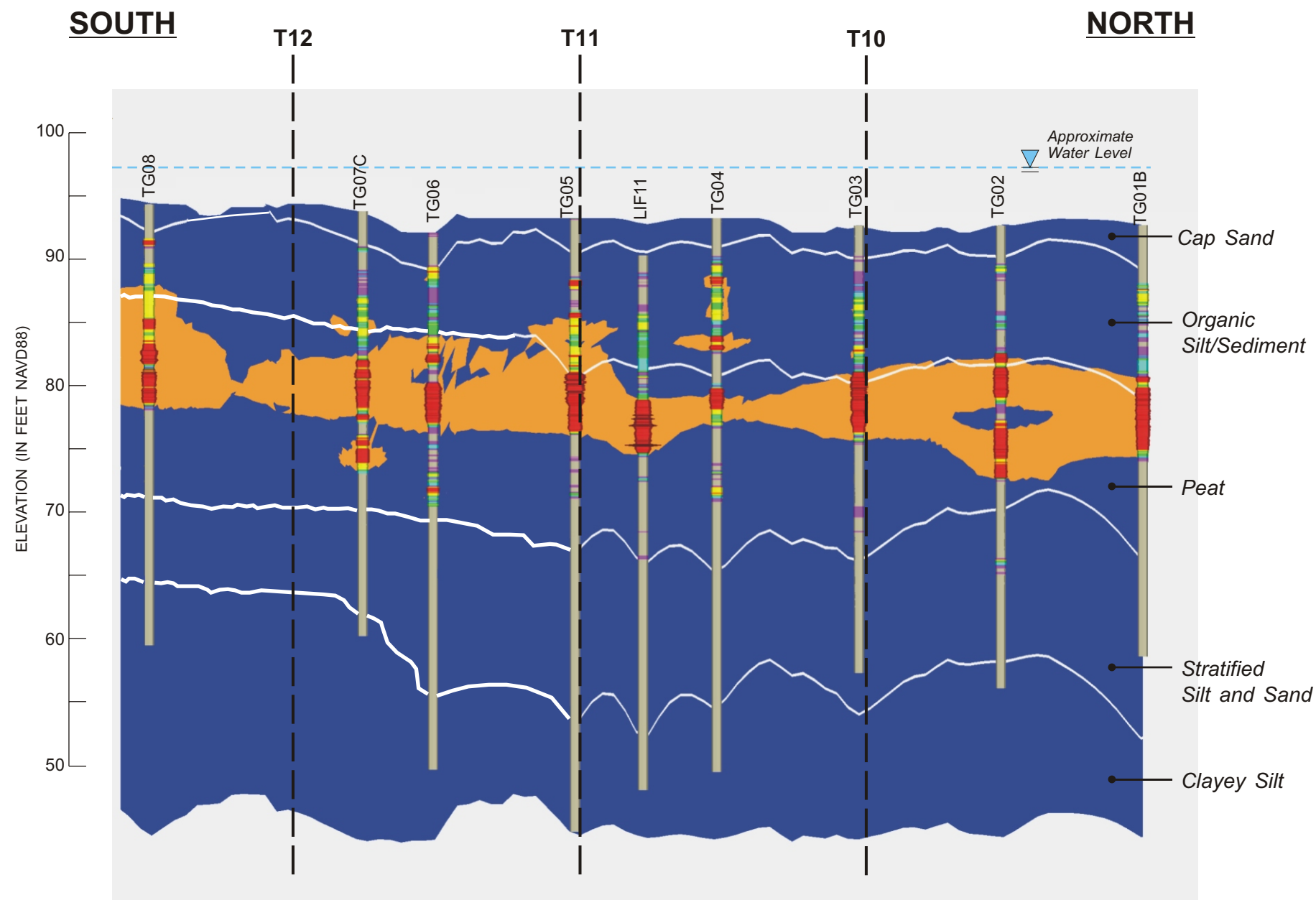
(VERTICAL SCALE IN FEET)
(VERTICAL EXAGGERATION X 5)

BURLINGTON, VERMONT
PINE STREET CANAL SUPERFUND SITE
FINAL NAPL INVESTIGATION REPORT

**3-D MODELING TARGOST™
DISTRIBUTION AND RAW TARGOST™:
SECTION C-C'**

 **ARCADIS** BBL
Infrastructure, environment, facilities

**FIGURE
4-8**



MODELED TARGOST™ DISTRIBUTION

= IMMOBILE NAPL OR ABSENCE OF NAPL

= POTENTIALLY MOBILE NAPL (TARGOST™ RESULTS GREATER THAN MOBILITY CRITERIA)

RAW TARGOST™ DATA

	≥ 400% FLUORESCENCE
	200% - 400% FLUORESCENCE
	150% - 200% FLUORESCENCE
	100% - 150% FLUORESCENCE
	50% - 100% FLUORESCENCE
	0% - 50% FLUORESCENCE

NOTES:
THIS DISTRIBUTION IS BASED ON THE 3-D MODEL AND MAY NOT REFLECT IN-SITU CONDITIONS

THE VERTICAL DATUM IS 1988 NORTH AMERICAN VERTICAL DATUM (NAVD88)

APPROXIMATE WATER LEVEL IS BASED ON WATER ELEVATION DURING THE 2006 SPRING INVESTIGATION AND IS INTENDED FOR ILLUSTRATION PURPOSES ONLY.

SECTION D-D'

APPROXIMATE GRAPHIC SCALE
(HORIZONTAL SCALE IN FEET)

12.5' 0 12.5' 25' 50' 100'

2.5' 0 2.5' 5' 10' 20'

(VERTICAL SCALE IN FEET)
(VERTICAL EXAGGERATION X 5)

BURLINGTON, VERMONT
PINE STREET CANAL SUPERFUND SITE
FINAL NAPL INVESTIGATION REPORT

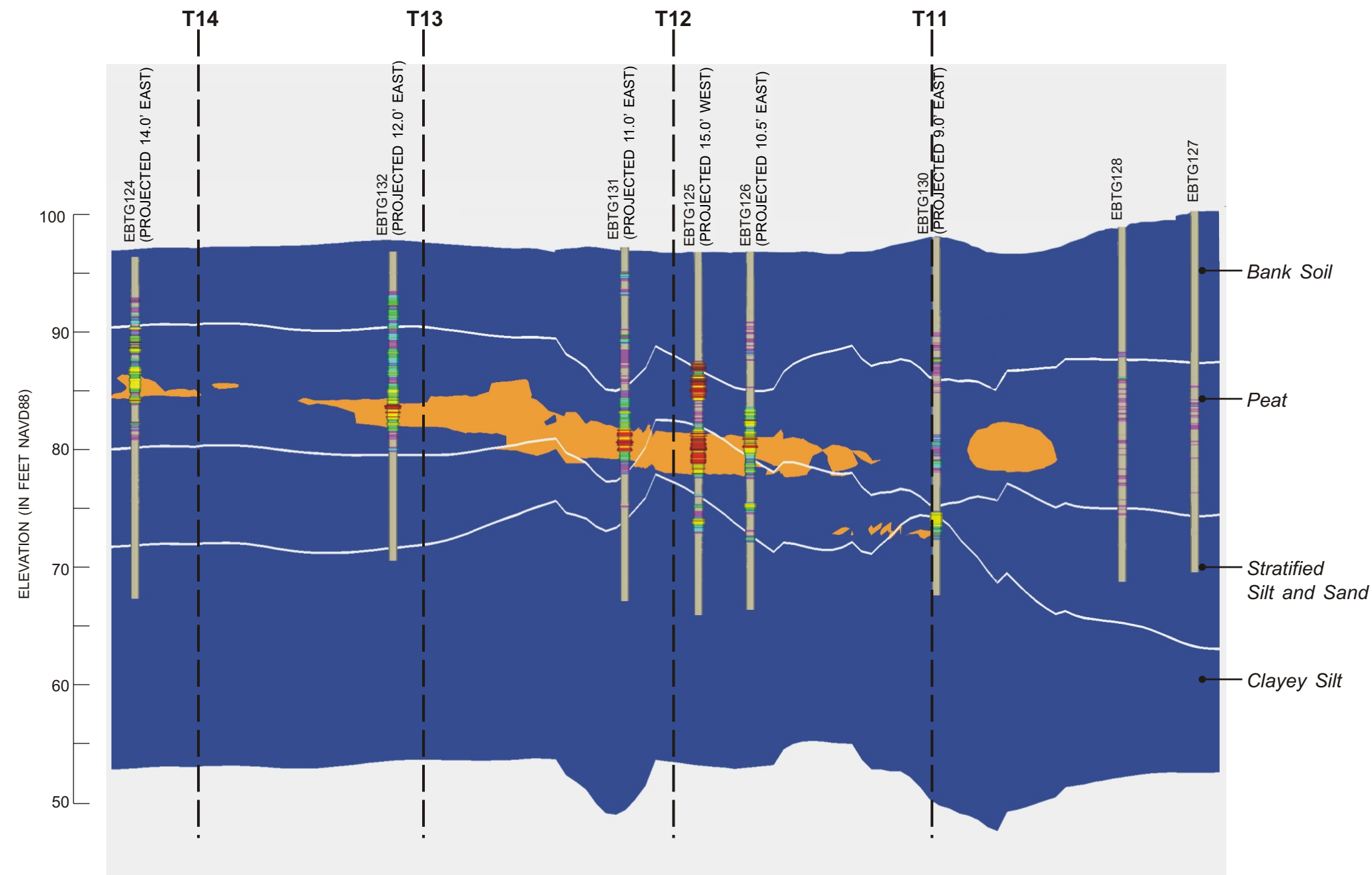
**3-D MODELING TARGOST™
DISTRIBUTION AND RAW TARGOST™:
SECTION D-D'**

 **ARCADIS** BBL
Infrastructure, environment, facilities



**FIGURE
4-9**

SOUTH







NORTH



MODELED TARGOST™ DISTRIBUTION

-  = IMMOBILE NAPL OR ABSENCE OF NAPL
-  = POTENTIALLY MOBILE NAPL (TARGOST™ RESULTS GREATER THAN MOBILITY CRITERIA)

RAW TARGOST™ DATA

-  ≥ 400% FLUORESCENCE
-  200% - 400% FLUORESCENCE
-  150% - 200% FLUORESCENCE
-  100% - 150% FLUORESCENCE
-  50% - 100% FLUORESCENCE
-  0% - 50% FLUORESCENCE

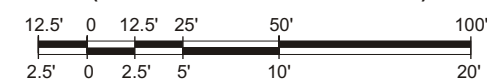
NOTES:
THIS DISTRIBUTION IS BASED ON THE 3-D MODEL AND MAY NOT REFLECT IN-SITU CONDITIONS

THE VERTICAL DATUM IS 1988 NORTH AMERICAN VERTICAL DATUM (NAVD88)

STRATIGRAPHY BETWEEN EBTG130 AND EBTG131 WAS DEVELOPED FROM CONFIRMATION BORINGS ALONG THE EAST BANK. STRATIGRAPHY NORTH OF EBTG130 AND SOUTH OF EBTG131 WAS EXTRAPOLATED FOR PURPOSES OF DEVELOPING THE 3-D MODEL.

SECTION E-E\'

**APPROXIMATE GRAPHIC SCALE
(HORIZONTAL SCALE IN FEET)**



**(VERTICAL SCALE IN FEET)
(VERTICAL EXAGGERATION X 5)**

BURLINGTON, VERMONT
PINE STREET CANAL SUPERFUND SITE
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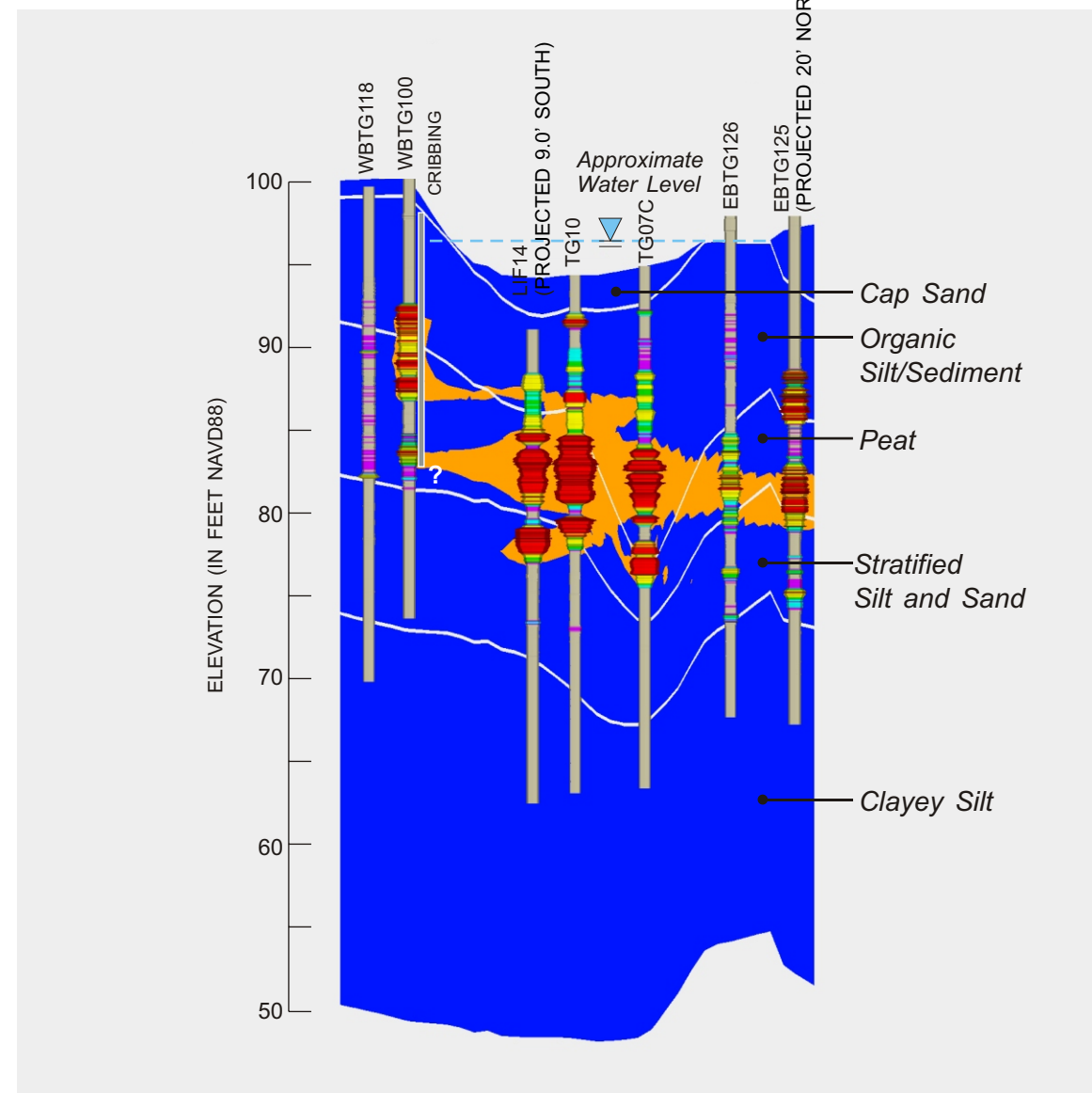
**3-D MODELING TARGOST™
DISTRIBUTION AND RAW TARGOST™:
SECTION E-E\'**


Infrastructure, environment, facilities



**FIGURE
4-10**

WEST







EAST



MODELED TARGOST™ DISTRIBUTION

-  = IMMOBILE NAPL OR ABSENCE OF NAPL
-  = POTENTIALLY MOBILE NAPL (TARGOST™ RESULTS GREATER THAN MOBILITY CRITERIA)

RAW TARGOST™ DATA

-  ≥ 400% FLUORESCENCE
-  200% - 400% FLUORESCENCE
-  150% - 200% FLUORESCENCE
-  100% - 150% FLUORESCENCE
-  50% - 100% FLUORESCENCE
-  0% - 50% FLUORESCENCE

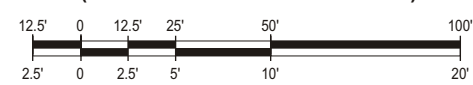
NOTES:
THIS DISTRIBUTION IS BASED ON THE 3-D MODEL AND MAY NOT REFLECT IN-SITU CONDITIONS

THE VERTICAL DATUM IS 1988 NORTH AMERICAN VERTICAL DATUM (NAVD88)

APPROXIMATE WATER LEVEL IS BASED ON WATER ELEVATION DURING THE 2006 SPRING INVESTIGATION AND IS INTENDED FOR ILLUSTRATION PURPOSES ONLY.

SECTION H-H\'

**APPROXIMATE GRAPHIC SCALE
(HORIZONTAL SCALE IN FEET)**



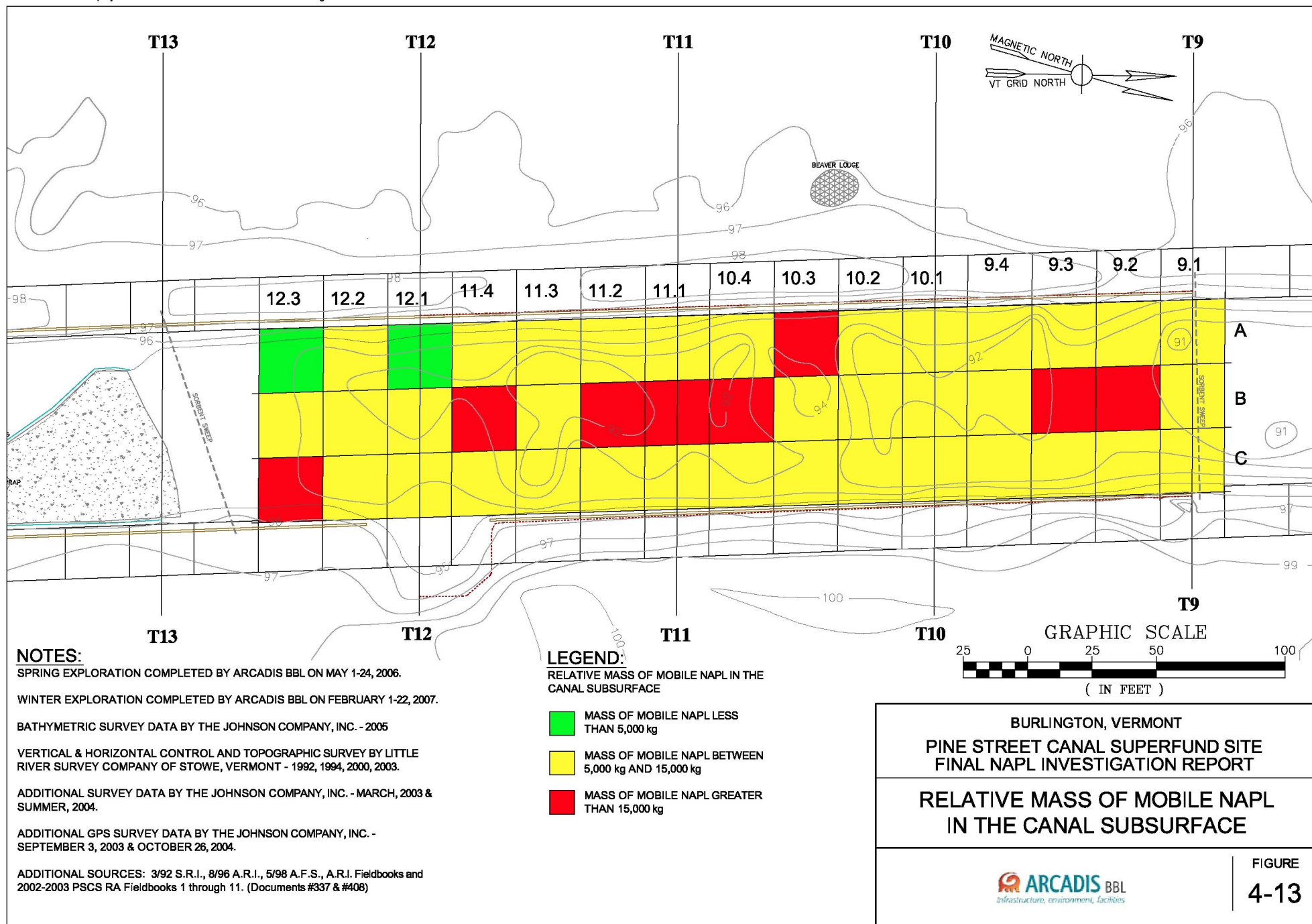
(VERTICAL SCALE IN FEET)
(VERTICAL EXAGGERATION X 5)

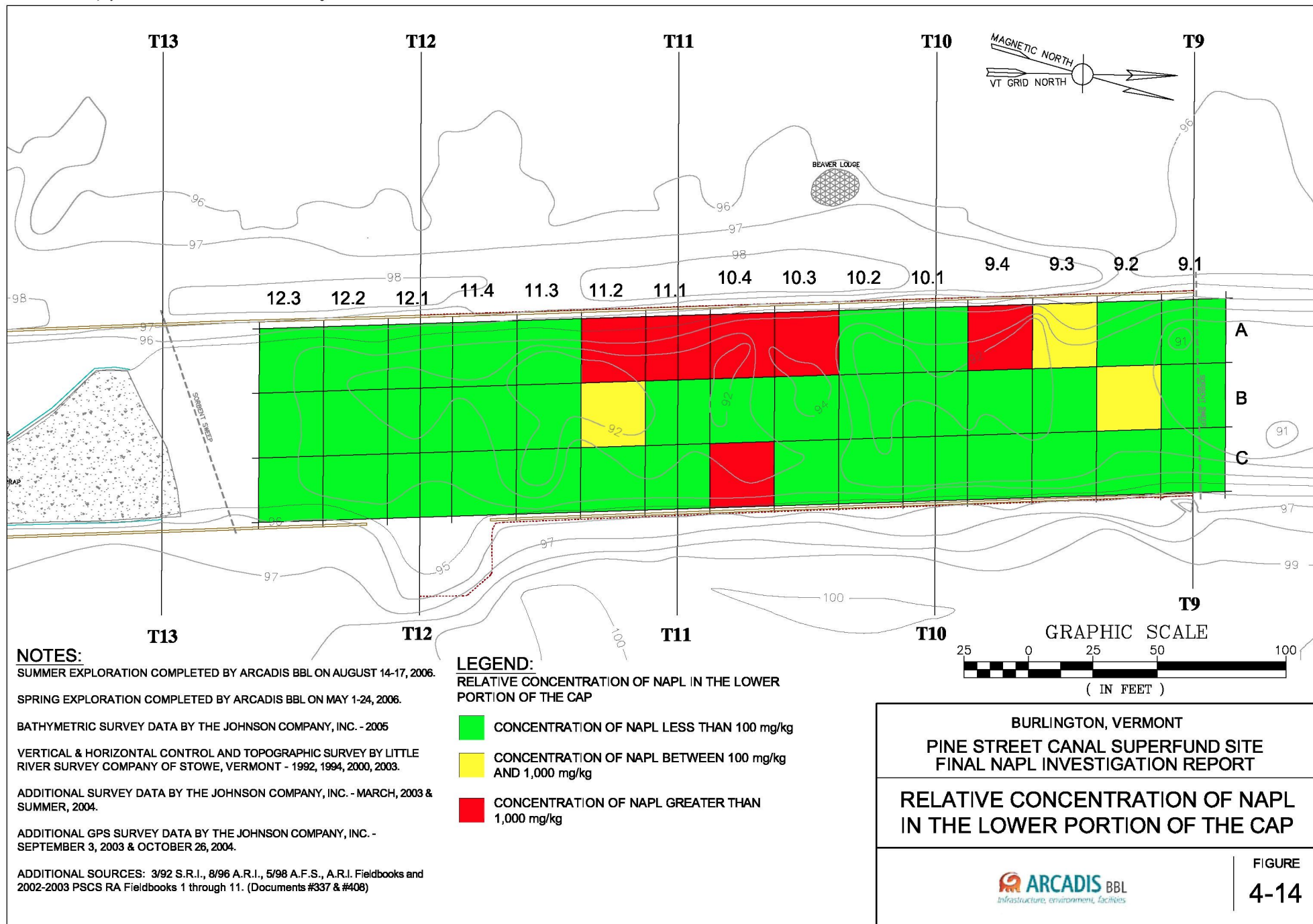
BURLINGTON, VERMONT
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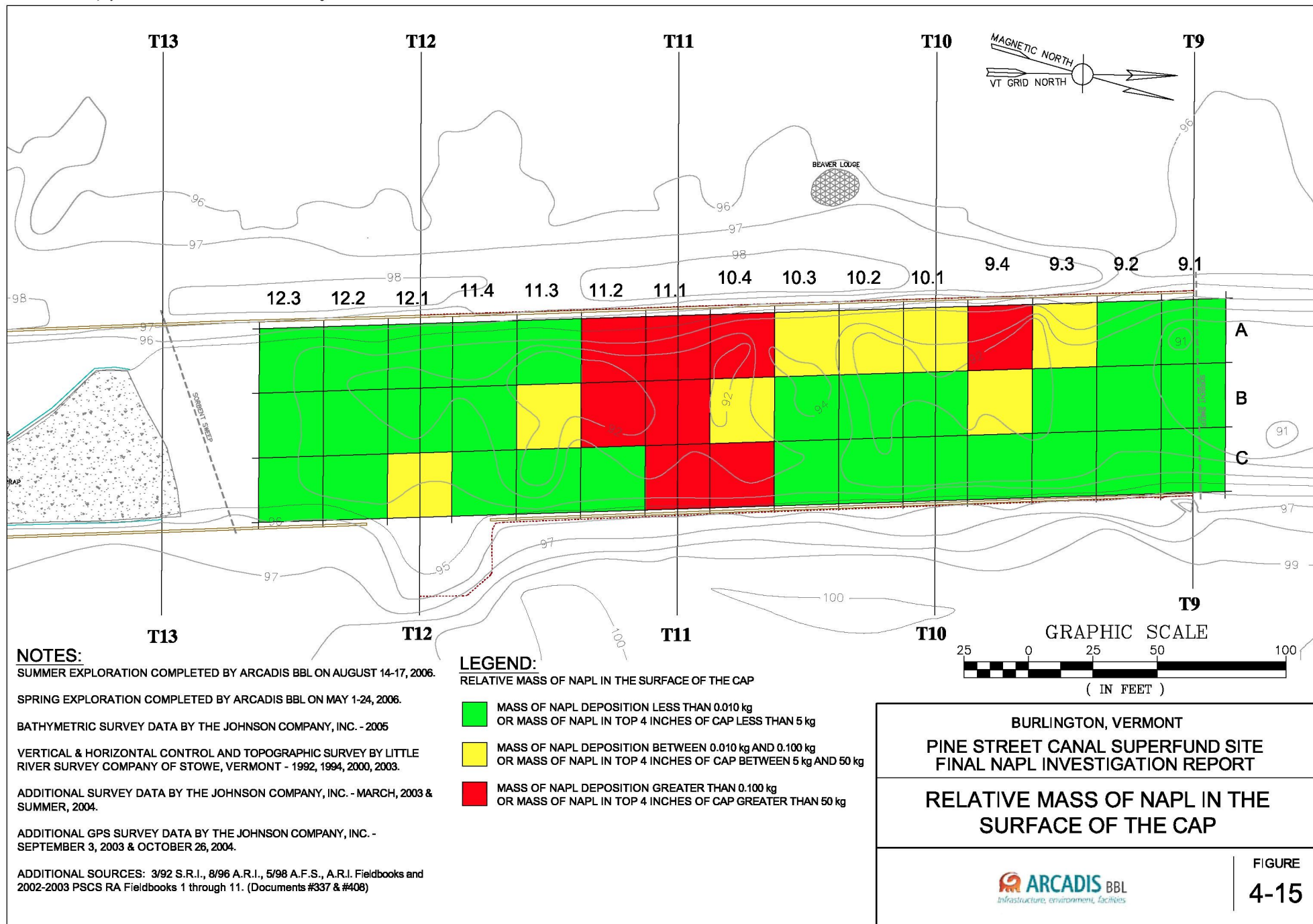
**3-D MODELING TARGOST™
DISTRIBUTION AND RAW TARGOST™:
SECTION H-H\'**

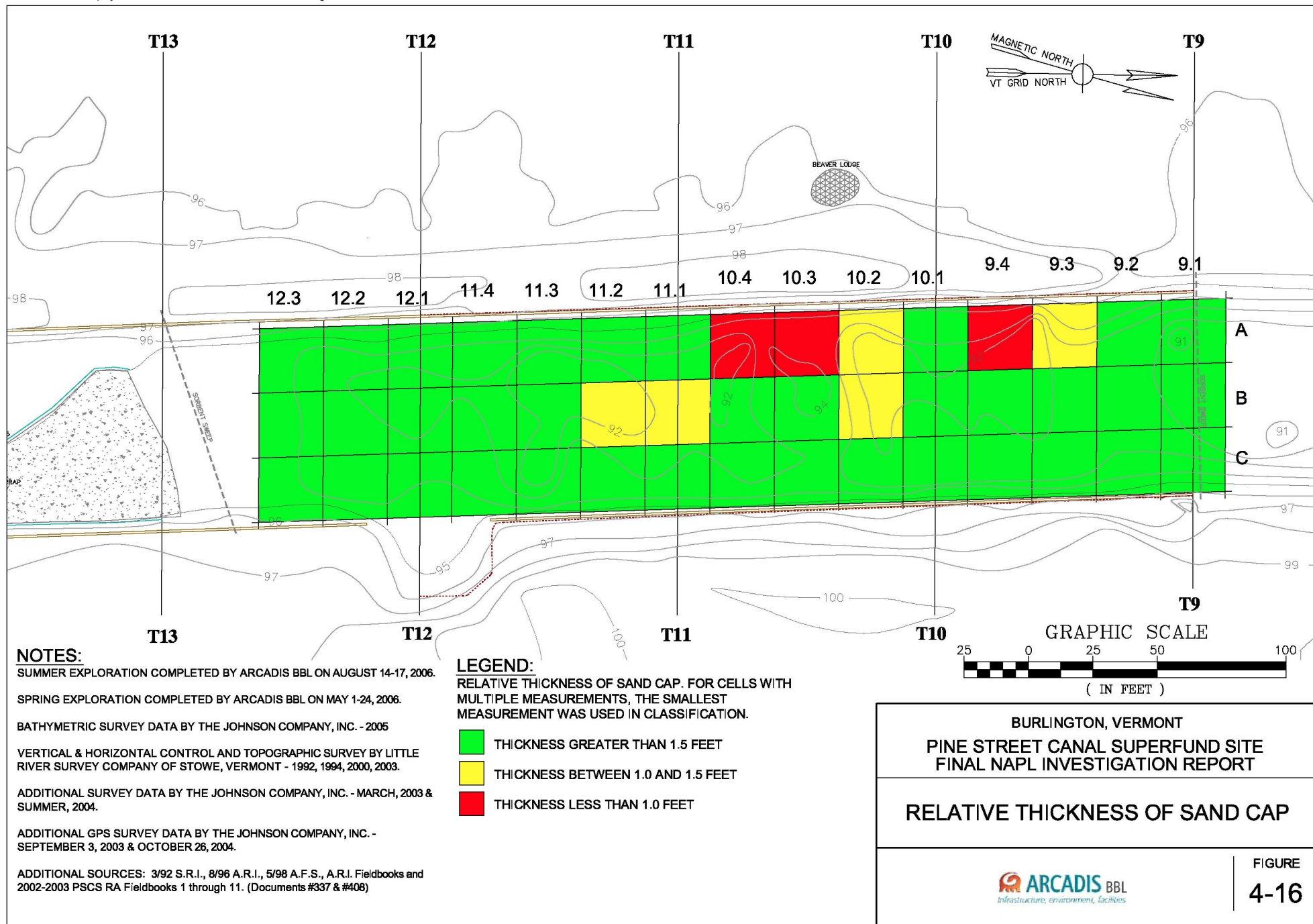


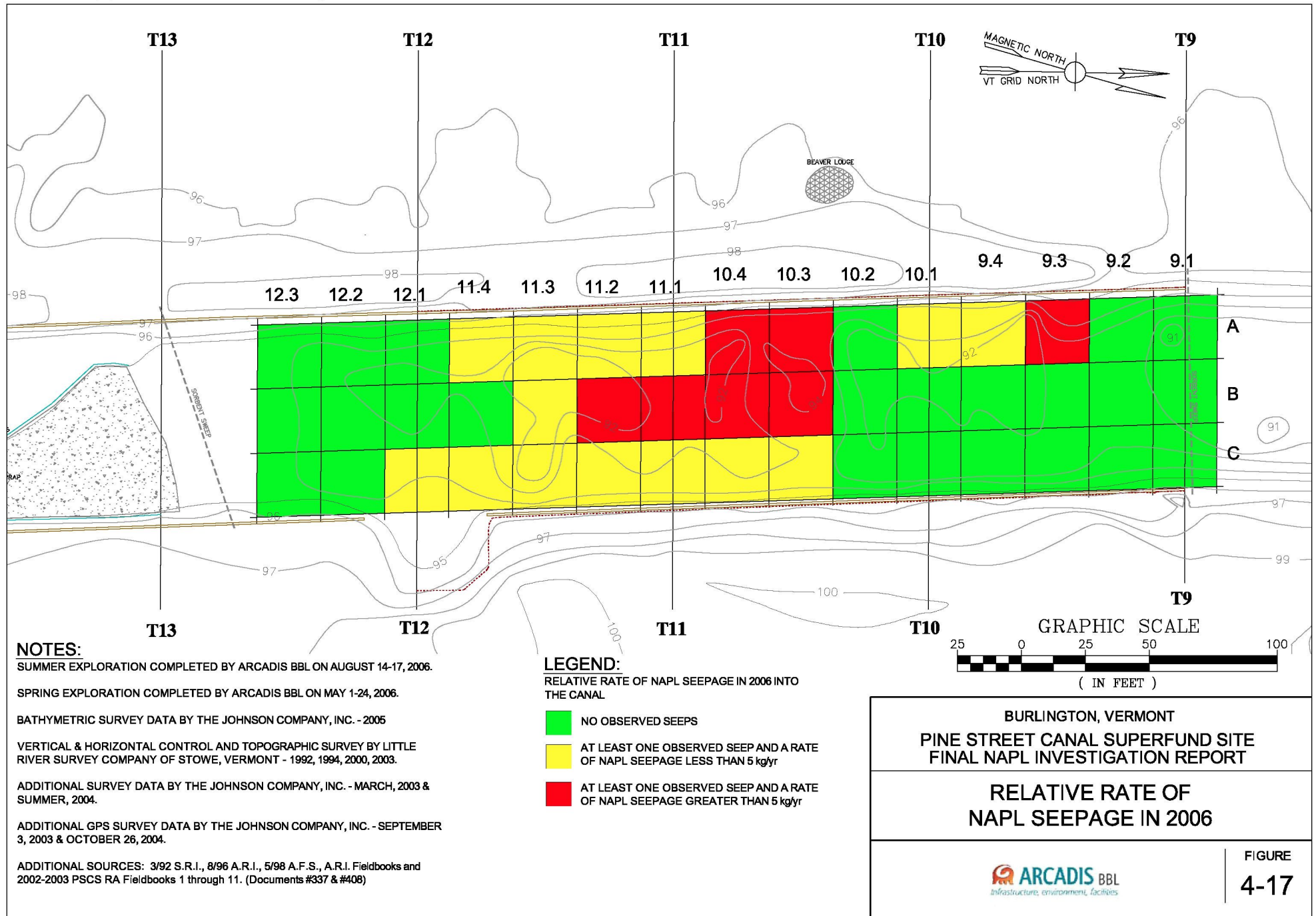
**FIGURE
4-12**

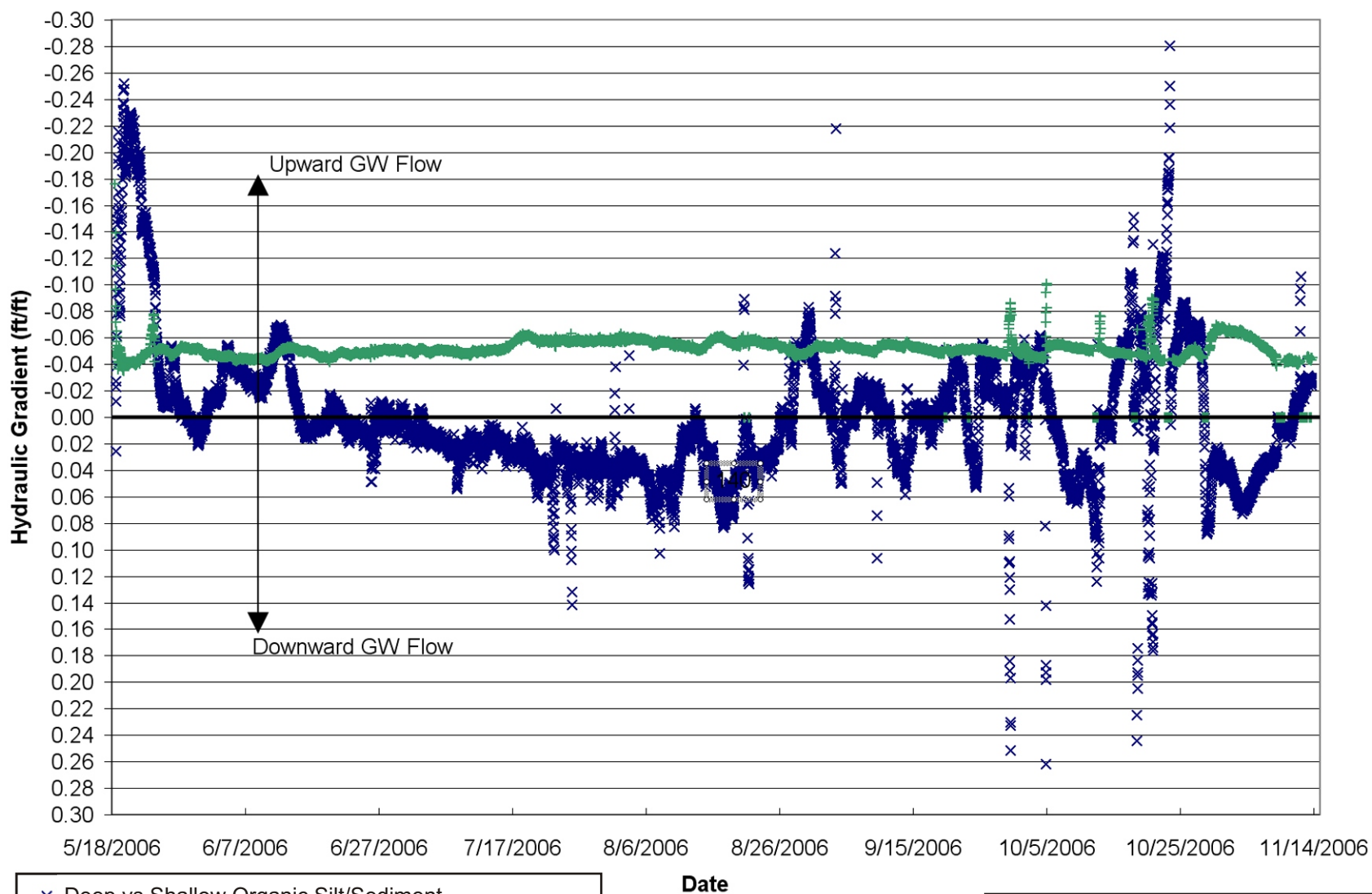












- × Deep vs Shallow Organic Silt/Sediment
- + Stratified Sand and Silt vs Deep Organic Silt/Sediment

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PINE STREET CANAL SUPERFUND SITE
FINAL NAPL INVESTIGATION REPORT

VERTICAL HYDRAULIC GRADIENT DATA

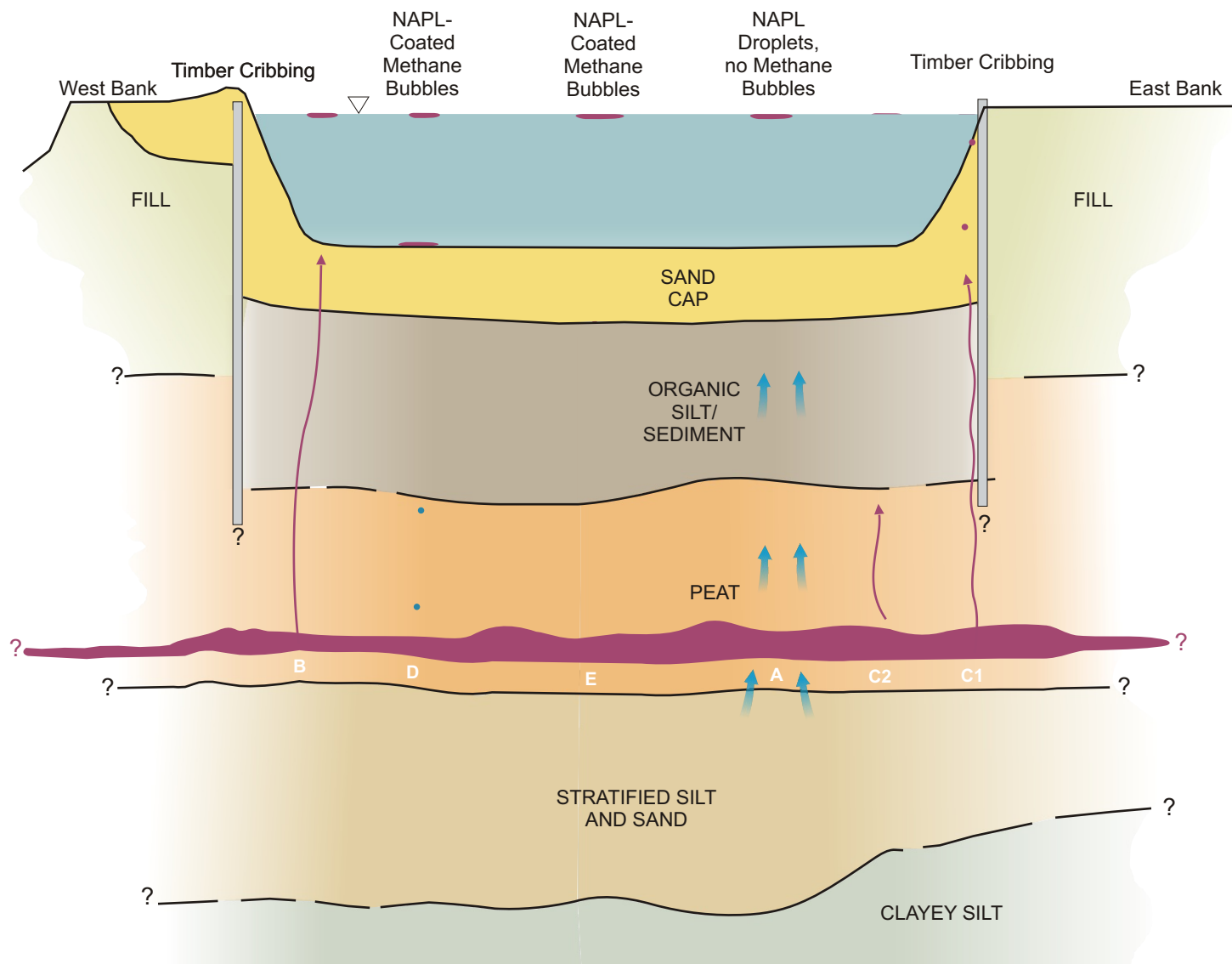


- PZ-100 strat silt/sand
- PZ-101 peat
- PZ-102 clayey silt
- PZ-103 peat
- PZ-104 peat

Screened Intervals (ft NAVD88)	
PZ-100	71.78 to 72.43
PZ-101	85.65 to 86.30
PZ-102	70.64 to 71.29
PZ-103	80.55 to 81.20
PZ-104	90.79 to 91.44

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PINE STREET CANAL SUPERFUND SITE
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HORIZONTAL HYDRAULIC GRADIENT DATA PLOT



Potential NAPL Migration Mechanism:

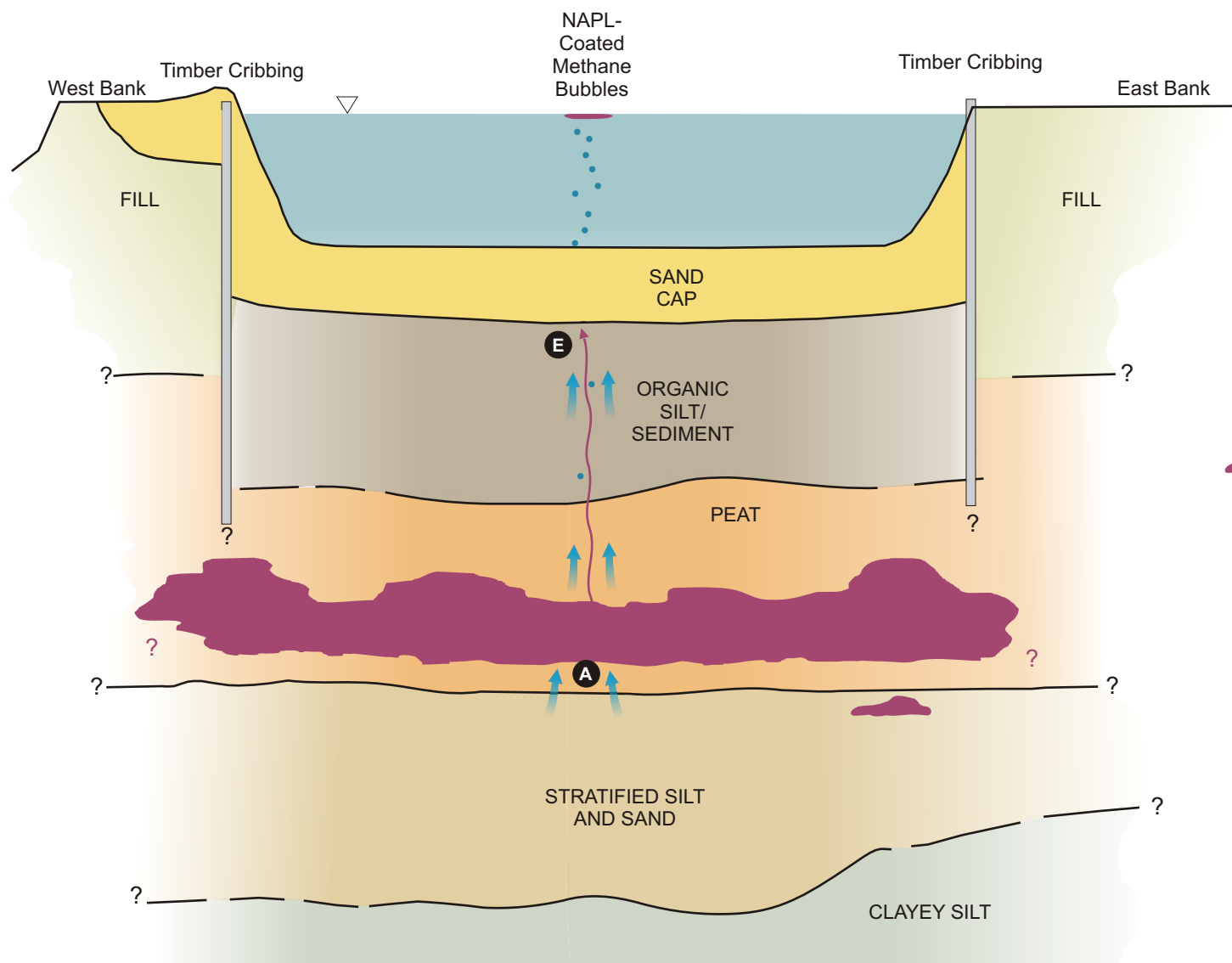
- A** Vertical hydraulic gradient
- B** Localized bearing-capacity failures and consolidation settlement
- C** Preferential pathways
 - C1 - Along Cribbing Wall
 - C2 - Through Sand Stringers
- D** Gas bubble-induced transport from the cap surface
- E** Gas bubble-induced transport from below the cap

- Methane Bubbles
- NAPL Droplets
- NAPL Deposits
- ↑ Groundwater Flow

NOTE: NOT TO SCALE

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PINE STREET CANAL SUPERFUND SITE
FINAL NAPL INVESTIGATION REPORT

HISTORICAL CONCEPTUAL SITE MODEL



NOTE: NOT TO SCALE

BURLINGTON, VERMONT
PINE STREET CANAL SUPERFUND SITE
FINAL NAPL INVESTIGATION REPORT

REVISED CONCEPTUAL SITE MODEL

